PETROLEUM PROCESSING

including Petrochemical Processing Section

OCTOBER 1953

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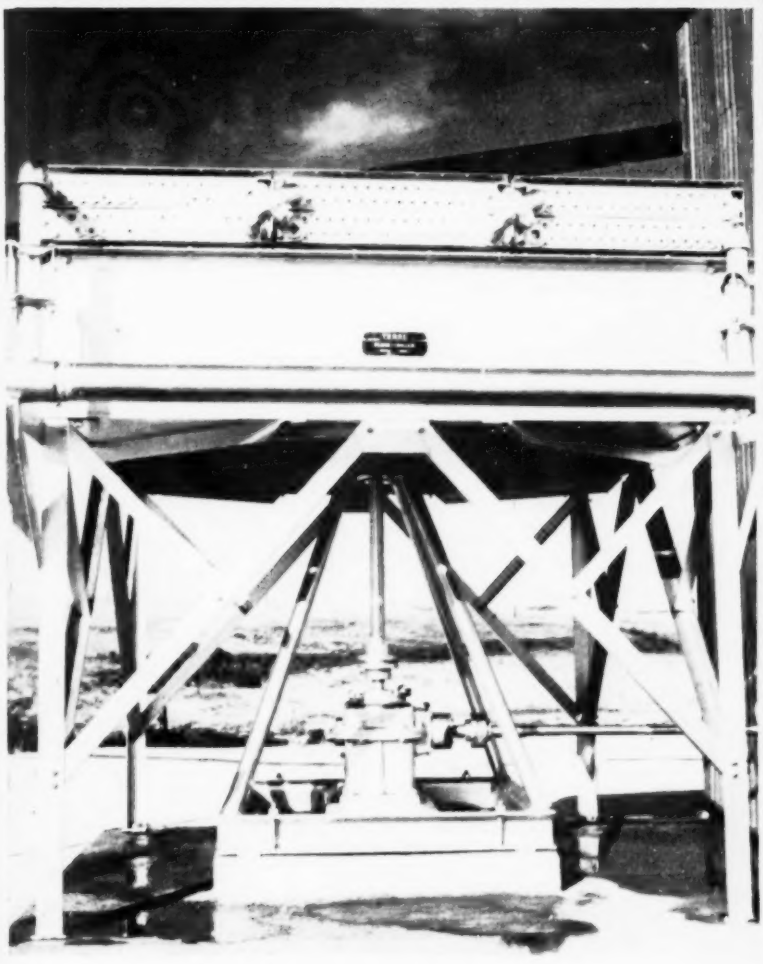

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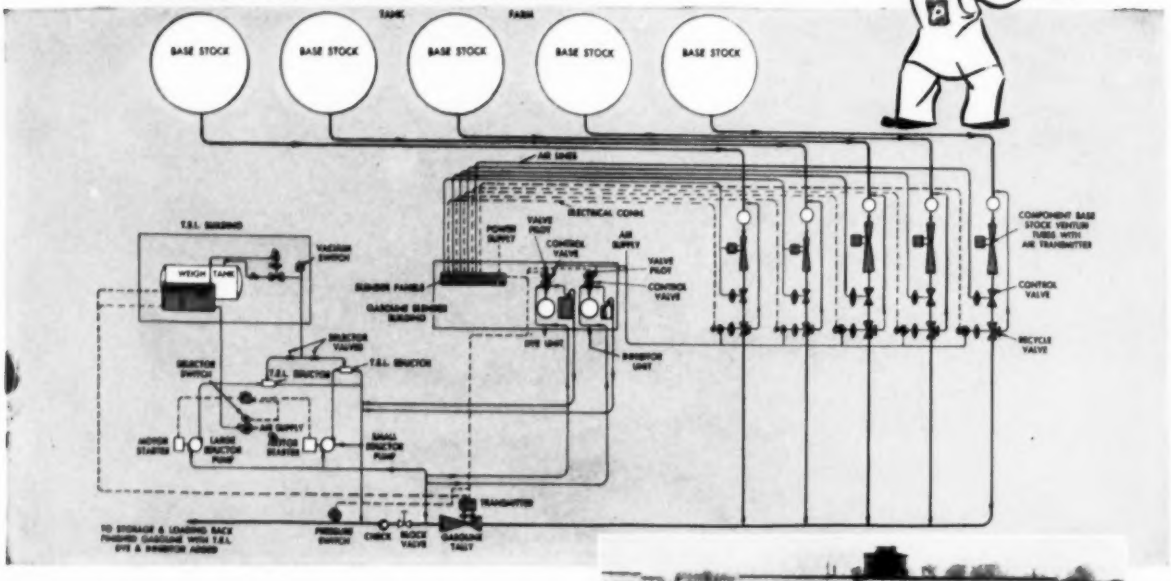
When and where it pays to use them—p. 1528

A McGRAW-HILL PUBLICATION

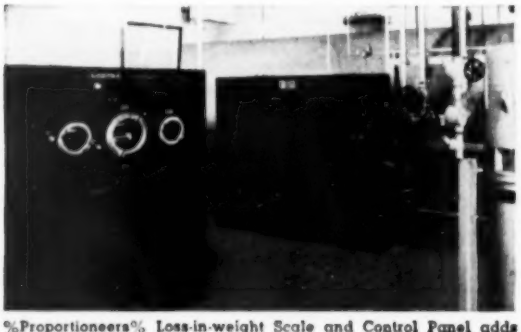
Are you still Batch Blending?

%PROPORTIONEERS% "ON-STREAM" BLENDING SYSTEM PROVIDES NEW SPEED, FLEXIBILITY AND ECONOMY IN THE DIRECT LOADING OF FINISHED GASOLINES

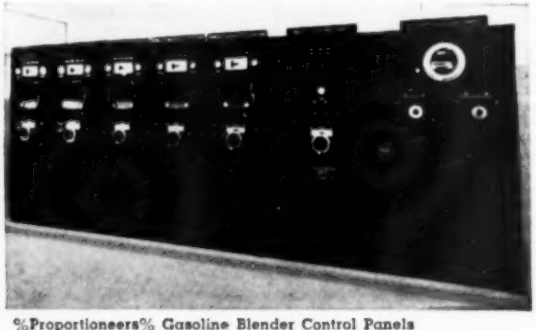


%PROPORTIONEERS% "on-stream" blending methods combine two or more liquid components in any proportion by weight or volume and formulations are maintained under all circumstances by automatic built-in "fail-safe" design features. Costly mixing tanks are eliminated, manpower and plant space saved, and internal transfer problems are greatly simplified. Ask for recommendations and descriptive literature.

New plant of Canadian Oil Refineries, Ltd. at Sarnia, Ontario, employs %Proportioneers% equipment to continuously blend five gasoline components, TEL, and dye, in producing its famous White Rose products at loading rates up to 2,880 barrels per hour. Photo shows Automatic Blend Manifold with Pump House and Control Room in background (TEL building in left hand corner).



%Proportioneers% Loss-in-weight Scale and Control Panel adds TEL to finished blend in proportion to flow rate.



%Proportioneers% Gasoline Blender Control Panels with automatic batch cutoff panel at right.

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Technical service representatives in principal cities of the United States, Canada, Mexico and other foreign countries.

Are we going up or down?

Sometimes you can't be sure in a helicopter without referring to the instruments. Nor can you always be sure of your exact position in the gasoline market without checking all your "reference points." Your own sales figures are only half the picture. You have to know how the whole market is doing to really see where you are going.

Years ago, Ethyl realized that what the industry needed was a monthly report of gasoline sales in each area. Then each oil company could plot its own sales against the trend.

So in 1931 we set up a system for gathering and reporting this information—keeping each company's sales in strict confidence—but releasing the important over-all figures.

(Continued on next page)

ETHYL

Printed in U.S.A.

Are we going up or down?

(Continued from preceding page)

The market report your company gets is called the "Ethyl Monthly Report of Gasoline Sales." It shows sales of regular and premium gasoline for each state and the percentage of change from the same period of the previous year. Information as to aviation gasoline sales is tabulated separately.

The report covers 97% of all gasoline sold in the United States, and it's tailor-made for gasoline marketers—it excludes naphthas, diesel and jet fuels, and is based on actual sales figures.

These monthly gasoline reports are an exclusive Ethyl service, which we're proud to perform for the petroleum industry.

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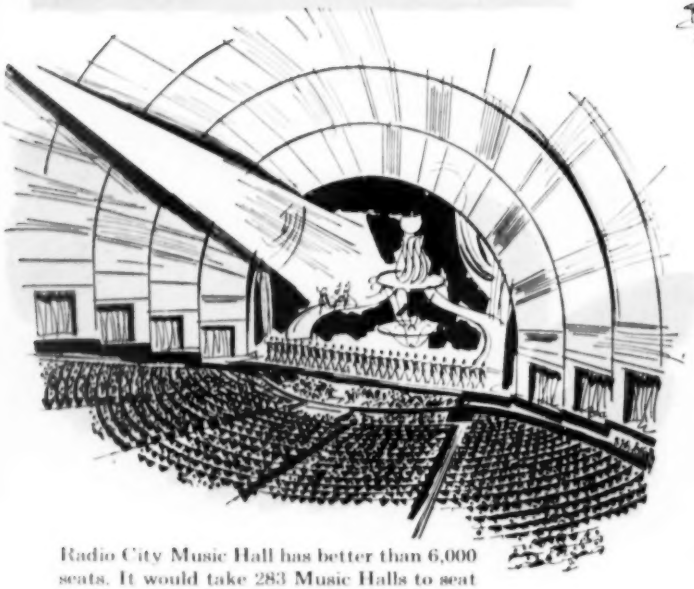
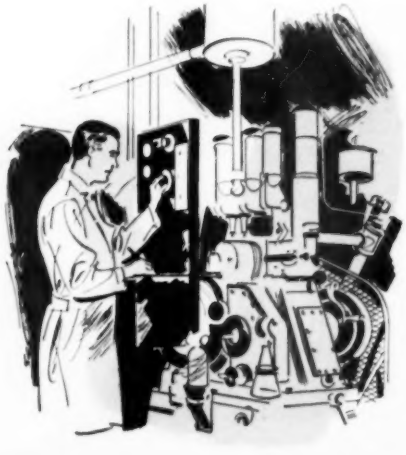
WORTH NOTING



Radio City Music Hall has better than 6,000 seats. It would take 283 Music Halls to seat all the people who saw Ethyl's educational films last year.

There were approximately one million tractors on farms in 1935 when the first high compression tractor—which Ethyl helped develop—was placed on the market. Today there are more than 4 times as many tractors! And this market alone accounts for some 3½ billion gallons of gasoline annually.



More than 15,000 gasoline samples are tested at Ethyl's five gasoline testing laboratories each year to furnish refiners with accurate gasoline quality reports.

Ethyl Service is backed by 30 years of antiknock experience

Another Wilson-Snyder Triplex Pump

. . . was selected for Reactor Charge Service in another "Platforming" Unit

by Elk Refining Company, Falling Rock, West Virginia

The Following Table

. . . presents a quick look at the performance range for six-inch stroke Triplex Plunger Pump:

Plunger Size, Inches	Maximum Working Pressure, psi	Displacement				
		Gallons Per Minute at Pump Speeds (rpm) of:				
		60	80	100	120	140
2	2800	15	20	25	30	35
2¼	2510	19	25	31	37	43
2½	2040	23	30	38	46	54
2¾	1680	28	37	46	56	65
3	1420	33	44	55	66	77
3½	1040	45	60	75	90	105
4	795	59	78	98	117	137
4½	630	74	99	124	149	174
Actual Brake Horse-power Required		32	43	54	64	75

Triplex Plunger Pumps also available in 4" and 8" stroke sizes.

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MORE AND MORE refinery men are specifying Wilson-Snyder Triplex Plunger Pumps. These compact, sturdy, positive-displacement pumps are being selected for high pressure process charge service in new construction, expansion and modernization programs by major and independent refiners everywhere.

At the Elk Refining Company Plant

. . . a horizontal six-inch stroke triplex pump, with direct electric-motor drive through a speed reducer, is used for reactor charge service in another Procon built, UOP platforming unit which went on stream November 11, 1952.

The capacity of this unit is 1,500 barrels per day and the gasoline produced has octane ratings well into the 90's. Naptha reforming charge stock at approximately 300°F. is pumped at approximately 750 psi, with 900 psi maximum, for this operation.

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number 3 of a series

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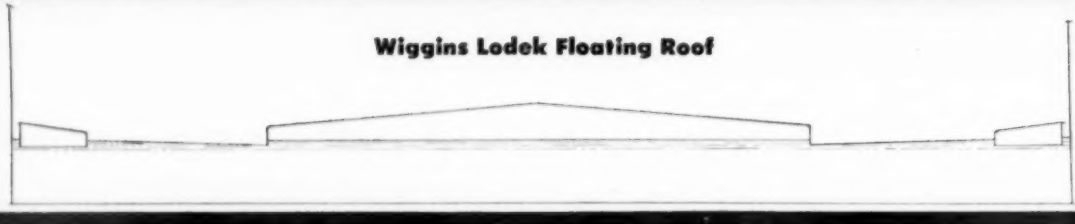

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PETROLEUM PROCESSING

Covering petroleum and petrochemical research and the design, construction, management, operation and maintenance of plants processing hydrocarbon materials into fuels lubricants and chemicals.

October, 1953
Vol. 8, No. 10

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IS LIQUID CARRY OVER–

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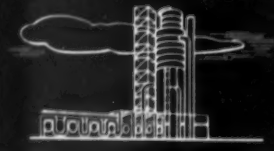
IF SO–GET THE FACTS ON METEX MIST ELIMINATORS!



Section of a METEX MIST ELIMINATOR, opened to show construction. They can be made of practically any metal, to combat corrosion. Factory cut to fit vessel dimensions and contour, there is no limit to the size in which they can be obtained.

Liquid entrainment need no longer be considered an unavoidable nuisance in processing operations, as more and more engineers are finding from experience. These *knitted* wire mesh entrainment separators literally "filter out" the entrainment (see diagram) and permit the gas to pass on, freed from the unwanted–and often contaminating–liquid.

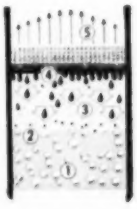
METEX MIST ELIMINATORS can be easily installed in new or existing vessels. They require no special housings, equipment or power–and need no servicing or attention. They function over a wide range of velocities with a pressure drop usually so low it cannot be measured. Users report efficiencies of 99% and more.

METEX Mist Eliminators can be used wherever the problem of liquid entrainment exists. By effecting complete removal of liquids, Mist Eliminators contribute to more efficient and economical processing in such vessels as:

- VACUUM PIPE STILLS
- FRACTIONATING TOWERS
- KNOCK-OUT DRUMS
- EVAPORATORS
- ABSORBERS
- SCRUBBERS
- COMPRESSORS
- SEPARATORS
- STEAM DRUMS

Write TODAY for free catalog giving complete information and engineering data. Or tell us about your SPECIFIC *entrainment problem.*

When a gas is generated in or passes through a liquid (1), it carries with it on leaving the surface (2), droplets of entrained liquid. These droplets are carried upward by the rising gas stream (3). As the gas continually changes direction in passing through the pad, the droplets are impinged on the extensive wire surface. Here the droplets coalesce, forming large drops of liquid which break away (4) from the pad and fall back through the gas stream. The gas (5) passes on, freed from liquid entrainment.



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METEX

Roselle, New Jersey

CATALYST CONTAMINATION CURED BY REMOVING ENTRAINMENT IN DISTILLATION UNIT

Equipment Costing $15,000 Pays Out In Under A Week For Large Southwestern Refinery

It was not a difficult problem to trace the cause of mounting catalyst losses to a cat unit feed so poor in color that it was essentially black. Entrainment of liquid from the bottom of the still column could be the only answer.

Here was a situation where a Metex Mist Eliminator would remove the entrainment – but what else might happen? Would this knitted wire mesh separator cause excessive pressure drop? How quickly would it become plugged by coke deposits and make the column inoperable?

Calculations by one engineer showed that the total cost of installing a 25-ft diameter Mist Eliminator, including designing and erecting supports within the still, was approximately $15,000 – less than a week's catalyst loss. After considerable study the decision was made, and the Mist Eliminator installed during the next routine turnaround.

When the first run of cat unit feed came from the remodeled crude distillation unit, it was crystal clear and water white. Throughout the normal run no differential pressure across the screen was found.

The problem was solved. Catalyst losses dropped sharply. And the Mist Eliminator has paid for itself in a matter of days.

Have you really analyzed your entrainment costs, and checked the savings a Mist Eliminator could make for you? Perhaps you are losing valuable end products in the exhaust stream. Perhaps you have a nuisance contamination problem. Perhaps the entrainment created in one vessel is causing trouble in a subsequent operation. For entrainment is an inevitable result of most processing and refining operations.

Metex Mist Eliminators perform just one function–and they are doing it in more and more refining vessels every day. They remove liquid entrainment–efficiently and economically–wherever it may occur.

Why not write today for more information on Metex Mist Eliminators. Or better yet, send data on your particular entrainment problem. We'll be glad to have our engineers check this, and send you our recommendations and suggestions.

PETROLEUM PROCESSING

Publisher's Page

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A "Bookkeeper's" Look at Combination Refining

IN MOST articles on new processing techniques and methods which appear in PETROLEUM PROCESSING, the effort of the author is to pack in as much technical data as possible; operating temperatures and pressures, characteristics of feed stocks and products and so on. Since the so-called combination refining was introduced, emphasis has been on economics. General statements have often been made about the savings that can be achieved through integrating crude distillation with catalytic cracking, reforming and other light ends processing in a combination installation, in place of building a refinery of individual processing units.

Exploring this subject in detail, this issue of PETROLEUM PROCESSING presents a contributed article, with several tables which even the head bookkeeper at the refinery, as well as the design engineers and others, will want to check through with a sharp pencil in hand. Capital investments, operating costs and personnel requirements of 10-, 20- and 40,000-bbl. installations of both combination and individual refineries are given. Close to the cost analyst's heart also will be the tables of many lines and columns which constitute overall economic balance sheets for hypothetical plants of both types of installations on both the East Coast and Gulf Coast.

Managers and operators of small refineries should find the article, "Economics of Combination Petroleum Processing" especially interesting. For, countercurrent to the general technological trend in processes, with combination installations the economics run in favor of the smaller capacity plants. Combination refineries of down to 2000-bbl. charge capacities have already been built and are reported operating profitably.

The cost comparisons presented in the article are of course on the basis of entirely new installations of both types. Modernizing the existing refinery of individual units to a "combination" installation would have to be tailored to the individual case. The article on the savings effected by combination petroleum processing had a top rating among PETROLEUM PROCESSING Editors who reviewed it. We believe numerous readers will share our opinion.

Virgil Guthrie

For the Editors

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What's Happening...

Refinery Expansion

. . . **Standard of Indiana** will build first commercial size Orthoflow catalytic hydroforming unit at Whiting, Ind. New unit, to be completed by end of 1954, will change 30,000 b/d low octane naphtha into high octane hydroformate for gasoline blend purposes. Indiana Standard helped develop new unit, which has reactor and regenerator in vertical alignment. M. W. Kellogg is prime contractor.

. . . **Pure Oil** has awarded contract to M. W. Kellogg for design and erection of a 3000 b/d catalytic reformer at its Heath, Ohio, refinery, employing new Sinclair-Baker platinum catalyst, for which Kellogg is sales agent (What's Happening, August, 1953, p. 1111). Kellogg is also the authorized designer of the new process. The reformer is expected to be completed by the second quarter, 1954.

. . . **Shell Oil Co.** has awarded Bechtel Corp. general construction contract for its 50,000 b/d refinery to be built at Anacortes, Wash. Products will start coming off line about mid-1955 when crude still and Platformer are scheduled for completion, with catalytic cracker slated for completion by end of 1955.

. . . **Union Oil of California** has assigned contracts for $6,350,000 of its projected $40,000,000 manufacturing expansion program, including two reforming units. Program calls for $5,750,000 at Oleum, where a 14,500 b/d feed capacity UOP Platformer will be built; and $600,000 at Cut Bank, Mont., where a 600 b/d Atlantic Catformer will be built. Contract with C. F. Braun & Co. calls for completing the Platformer by November, 1954. Bechtel Corp. has contract for outside facilities, utilities and tankage required for the Platformer. Ralph M. Parsons Co. has contract for Cut Bank project.

Future projects at Oleum include catalytic desulfurization, coking, sulfur removal, gasoline facilities, and auxiliaries.

. . . **Canadian Petrofina, Ltd.,** a new company, has split contracts for construction of its 20,000 b/d refinery in Montreal area between M. W. Kellogg Co. and Lummus Co. A 20,000 b/d TCC unit is expected to be included in plans along with primary distillation unit, vacuum still, catalytic polymerization plant, catalytic reforming, and hydrodesulfurization. Completion of estimated $20,000,000 project is scheduled for late 1955. Petrofina will buy products from Canadian and U. S. companies for supplying its initial retail outlets until new refinery is operating.

. . . **Imperial Oil, Ltd.,** has awarded contract for major portion of $10 million expansion and modernization program at Montreal East refinery to Canadian Bechtel. Work, to start at once, will increase capacity from 46,000 to 58,000 b/d through installation of combination still and vacuum pipe still (What's Happening, April, '53, p. 449).

. . . **Ucan Products Co.** has awarded construction contract for its projected delayed coking unit of 9000 b/d capacity to Lummus Co. The Duncan, Okla., plant is scheduled for completion late in 1954.

. . . **R. A. Goodall,** an Ogallala, Neb., oil operator, plans to build a $1,000,000 gasoline plant in the Little Beaver Creek field in northeastern Colorado, to operate on about 10 million cu. ft. daily of gas. Announcement came day after Goodall had obtained authority from Colorado Public Utilities Commission to build a 43-mile pipe line from the oilfield to Merino, Colo., for connection with Toronto Pipeline Co.'s line to eastern markets. The 6 and 8-in. line, costing about $1.1 million, will carry 12 to 18,000 b/d crude. Goodall is negotiating with Continental and Lion for association with him in gasoline plant.

. . . **Sinclair Refining Co.** is preparing plans for the installation of a new 20,000 b/d gasoline fractionator at East Chicago. Estimated cost is $1,300,000 and work is to be completed early in 1954.

. . . **Shell Oil** has awarded Fluor Corp. contract for second major extension to Elk City, Okla., gasoline plant, with completion scheduled for next spring. Project will increase plant's daily rated intake capacity of gas from 150 million cu. ft. and gas injection capacity from 135 million cu. ft. to about 210 million. Liquid products output will be hiked about 50%.

. . . **Taylor Oil & Gas Co.** has put onstream its second UOP Platforming unit, becoming first independent refinery with two in operation. Located at Corpus Christi, new unit has design charge capacity of 5000 b/d and is currently producing about 4500 b/d of stabilized Platformate with 96 octane number, with 3 cc. TEL. Provision has been made for conversion to aromatics production also.

. . . **Pan American Refining Co.** will locate its proposed new 25,000 b/d East Coast refinery on a 1,000-acre site at mouth of York River near Newport News, Va. Company has options for purchase of intended site, and schedules completion of the project by late 1955.

. . . **Standard of Ohio** will spend about $400,000 on equipment designed to eliminate a vapor plume on catalytic cracking unit at its Cleveland No. 1 refinery. Sohio worked with Cleveland Division of Air Pollution Control on pilot plant studies to develop methods. Construction will require up to 18 months.

. . . **Skelly Oil** has started third expansion of its No. 2 gasoline plant at Eunice, N. M. New facilities will permit processing an additional 20 million cfd of gas with extraction of 60,000 gal/day saleable liquid products. J. E. Carlson Construction Co. has contract, with completion expected in April, 1954.

Information on these pages is obtained through the nation-wide news coverage of PLATT'S OILGRAM NEWS

. . . **Sunray Oil Corp.** will build a 5000 b/d Platforming unit at its Sunray Village refinery, Duncan, Okla., with completion anticipated by third quarter of 1954. Avgas base stocks from new unit will be in addition to those obtained from new alkylation plant now being activated.

. . . **The Texas Co.** plans a catalytic polymerization unit at Sunburst, Mont., estimated capacity of 37,700 bbl/yr, and completion expected late this year.

. . . **New petroleum processing plant expansion** to look for, as indicated by rapid tax amortizations announced last month:

Williston Basin Refining, $415,835 for 1500 b/d refinery at Williston, N. Dak.

Rock Island Refining, $593,000 for 1800 b/d catalytic reforming unit at Indianapolis, Ind.

Tide Water Associated Oil Co., $2,175,000 for basic refinery expansion at Avon, Calif.

Moran Gasoline Corp., $488,100 for natural gasoline plant at Chandler, Okla.

Barnhart Hydrocarbon Corp., $91,400 for isobutane separator at Big Lake, Texas.

Pan American Souther Corp., $25,899 for 16,500 b/d Petrolite crude desalting unit at Destrehan, La.

Pan American Refining Corp., $2,900,000 for 2960 b/d alkylation unit at new refinery at Goodwin Neck, Va.

Petrochemicals

. . . **Standard of California** has begun commercial shipments of paraxylene from its new plant at El Segundo, now tripling the company's output of this chief raw material for such synthetic fibers as Dupont's Dacron. Product is to be marketed through Oronite Chemical Co., a wholly-owned subsidiary engaged in petrochemicals sales.

. . . **Indiana Standard's** recently completed detergent alkylate plant at Whiting, Ind., is now in production. Product sales will be handled by Indoil Chemical Co., Standard's chemical subsidiary.

. . . **U. S. petrochemicals output was down in 1952** as compared to previous year, according to Tariff Commission. Benzene went down to 252 million gals from 266 million; toluene went up to 105 million gals from 101 million; xylene down to 72 million from 76 million; and crude naphthalene was 322 million lbs., 9.3% under 1951 value.

. . . **Shell Chemical Co.** has contracted with Westoil Terminals to build 100,000 bbl. of petrochemical storage at the latter's tank farm on the San Pedro, Calif., waterfront. Project, estimated at about $500,000, calls for four tanks of 25,000-bbl. capacity each, tank-car and tank-truck loading racks, and dock lines. Products, isopropyl alcohol, acetone, methyl ethyl ketone, and methyl iso-butylene, will reach terminal by truck and rail from Martinez and Dominguez. Westoil will build, own, and operate terminal on five-year contract.

Markets, Prices

. . . **Crude oil price cut** on Pennsylvania grade of 50¢/bbl. highlighted September markets. Trading in refined products continued slack despite more seasonable weather that followed the late August record heat wave, but prices were unchanged generally.

. . . **September drop was sharpest in years.** South Penn Oil Co. reduced its top-grade Bradford district oil to $4.05 per bbl. on Sept. 21, more than wiping out two increases the company had made earlier this year. When Office of Price Stabilization lifted price controls last February, South Penn immediately advanced its Penna. grade postings 15¢, and on August 1 again upped them in amounts ranging from 13 to 15¢.

South Penn President Grunert cited increased production in several areas of Penna. field and rising inventories of both crude and refined products as reasons for price cut.

. . . **Southwest and mid-continent crude markets** were not expected to see action touched off by Penna. reduction, although trade sources agreed generally that markets in those areas were weak. Late September reports for most Gulf Coast refiners indicated anywhere from 100,000 to 500,000 bbl. excess crude in storage.

. . . **In refined oils,** buyers continued to out-wait sellers. Jobbers and distributors for most part were well stocked to meet early fall demand for heating fuels. With inventories still rising at primary supply level, they apparently saw no reason to extend themselves on commitments over and above contract takings beyond October.

. . . **Gasoline supplies also were abundant** in all primary markets, and there were widespread reports that prices quoted by suppliers were being discounted. Residual fuels remained about the only relatively firm item in the list of refined oils.

Looking Ahead

. . . **Higher compression ratios** in next year's automobiles are a good probability. Oil industry people who have talked off-the-record with the Detroit automotive engineers indicate that at least GM and Ford are anxious to push just as high compression as they can—and to do so just as rapidly as refiners make the higher octane (and higher cost) fuels that such engines require. Ford in particular is expected to make sizable boosts in its '54 models, yet remain in the regular grade fuel class.

. . . **Oil from tar sands** may be in the not-too-far-distant future. W. M. Barnes Co., Los Angeles engineers and constructors, has been conducting pilot plant experiments on an extraction process utilizing Utah tar sands and now thinks it is technically and economically ready for commercial operation. The oil produced is "similar in characteristics to a virgin gas oil, low in sulfur and nitrogen, and susceptible to conventional processing techniques, such as catalytic cracking," according to one source.

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 (*To obtain more data on advertised products see page* 1584)

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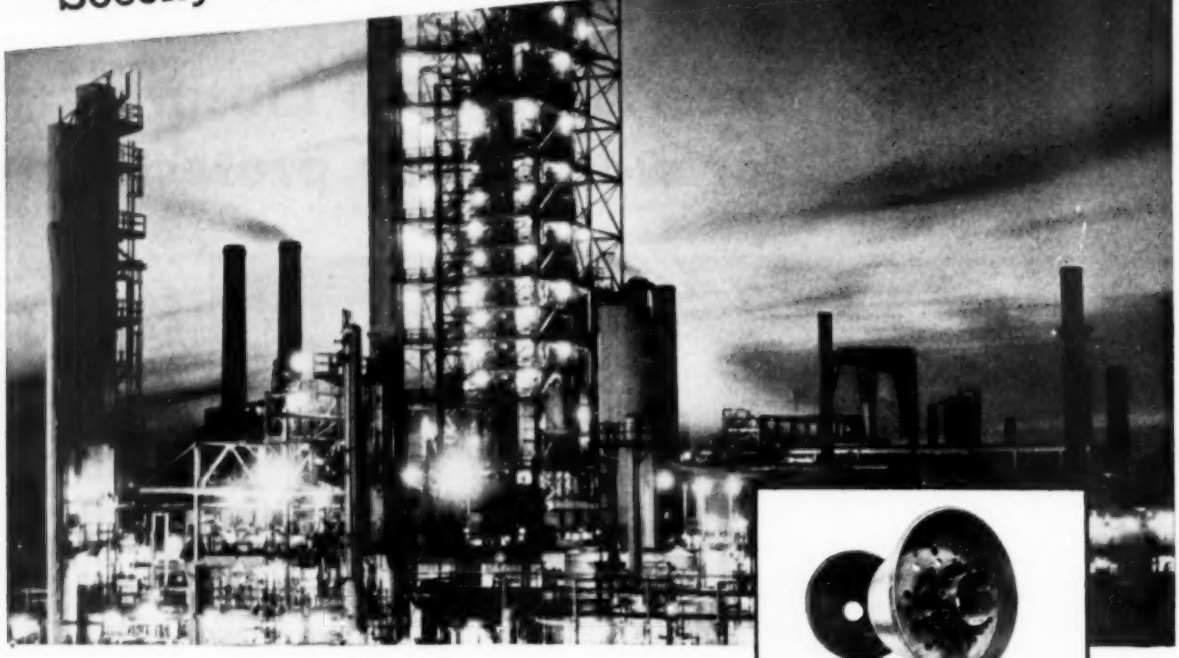

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These units are essential parts of a revolutionary design, the features of which Socony-Vacuum has recently adapted to small refineries, employing the same general principles.

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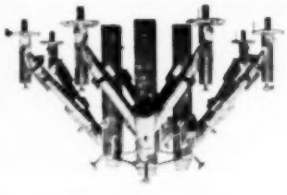
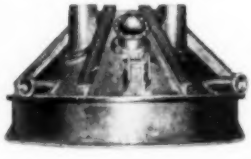


Catalyst Feed Lines



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Your Process May Be Better— But It May Lose on Taxes

TAXES are one of those things which we are told we can be sure of—along with death. And taxes are usually considered to be necessary and worthwhile, as long as they aren't too high.

But what we frequently don't appreciate is the detrimental effect which taxes can sometimes have on progress in the development of new processes and products.

Two engineers with California Research Corp. stressed this effect quite strongly in a talk they gave at the recent meeting of the American Institute of Chemical Engineers in San Francisco.(1)

"Taxes," according to them, "have become a very important consideration in our ability to recover our capital investment. At extremely high tax rates, there is a tendency for modern processes, which are generally more expensive for initial installation, to suffer in comparison with lower-risk plants of established processes. At lower tax rates, more modern, more efficient plants could be installed, whereas with higher tax rates it is considerably more difficult to make advances."

As an example they cited the case of two processes for making ethylene oxide—the older and established chlorohydrin route vs. the newer direct oxidation route.

A 30 million lb./yr. plant using the newer process would require twice as much capital investment as the same size plant using the older route—$6 million as compared with $3 million. But the newer process has considerably lower operating costs—9.9¢/lb. of ethylene oxide product as compared to 14.4¢/lb. for the chlorohydrin process.

The lower operating cost gives the new process an advantage of 4.5¢/lb. of product. That advantage can be utilized to offset the increased capital investment, and to get back the initial investment in four years—an acceptable payout period for new petrochemical plants.

As shown in the accompanying table, if no taxes had to be paid, the newer process could be amortized in 4 yrs. (including 4% return on outstanding investment) at a return of 5¢/lb. of product for the direct oxidation process, and 2.5¢/lb. for the chlorohydrin process. That leaves the new process a net advantage of 2¢/lb.

At a 50% corporate income tax rate, the new process still has a slight edge—0.5¢/lb. But if the plant owners are required to pay taxes in the region of the so-called excess profits—80% or more—then the chances for the new process being applied are hopeless. The money required for a 4-yr. payout is 17¢/lb. for the direct oxidation process and 8.5¢/lb. for the chlorohydrin process, and the advantage of low operating cost is wiped out completely.

"It would be difficult under the circumstances," the authors conclude, "to prove to management the desirability of installing a process which from the engineer's point of view is a marked improvement. Even though a new plant may be efficient enough to pay for the high costs of installation before taxes, the high tax rates decrease the probability of being able to develop improvements that will be economically attractive."

Although the figures cited here certainly aren't absolute, they do serve to illustrate the point. High taxes increase the amount of earnings required to realize a payout on capital investment. The result is a dampening effect on the development of new techniques for manufacturing products—techniques which may be much more efficient but require greater capital investment. —W. F. B.

(1) "Consideration of Capital Costs for a Petrochemical Project," by E. B. Chiswell and J. J. Merrill, California Research Corp., presented before the American Institute of Chemical Engineers, San Francisco, Calif., Sept. 13-16, 1953.

Return Required for Ethylene Oxide Plants at Various Tax Rates

(30,000,000 lb./yr. plant capacity)

	Direct Oxidation	Chlorohydration
Capital Investment Required	$6,000,000	$3,000,000
NO TAXES:		
Raw Material and Operating Costs, ¢/lb. of product	9.9	14.4
Return Required for 4-yr. payout, ¢/lb.	5.0	2.5
Total Production Cost, No Taxes, ¢/lb.	14.9	16.9
50% TAX RATE:		
Raw Material and Operating Costs, ¢/lb. of product	9.9	14.4
Return Required, 4-yr. Payout, 10% Depreciation, ¢/lb.	8.0	4.0
Total Production Cost, 50% Tax Rate, ¢/lb.	17.9	18.4
80% TAX RATE:		
Raw Material and Operating Costs, ¢/lb. of product	9.9	14.4
Return Required, 4-yr. Payout, 10% Depreciation, ¢/lb.	17.0	8.5
Total Production Cost, 80% Tax Rate, ¢/lb.	26.9	22.9

Bacteria and Fungi May Solve Refinery Waste Disposal Problems

THE use of microbiological cultures to render refinery wastes innocuous from a pollution standpoint may provide the solution to a lot of refiner's waste disposal headaches. Already the City of Tyler, Texas, is using such cultures to clean up refinery wastes in its municipal sewage disposal plant, which originate in the McMurrey Refining Co. plant and are processed by the city under contract. At least one major oil company and a large chemical company on the Gulf Coast are making tests to see if the idea will work for them also.

Developer of the microbiological cultures is a recently launched firm, Reliance Chemicals Corp. with a plant in Salem, Ill., and soon to have one in Houston, along with laboratories already established at the latter point. The biological materials are supplied as a dry powder, incorporating generally synergistic combinations of bacteria with fungi to achieve the desired effect.

Specially bred cultures, these microorganisms produce enzymes which attack specific compounds. Among the jobs

for which these cultures are being tried out, in addition to oil, are the breakdown of phenols, aldehydes and cyclic compounds; accelerated oxidation of paper mill waste; cannery, textile mill and citrus processing wastes; treating of sugar mill wastes and the like.

Reliance isn't ready yet to declare it has a solution for refinery waste problems. The wrinkle is to find the right combination of microorganisms. Consequently, much further study in both pilot and semi-plant trials is necessary because what will work well in one case may be useless in another.

Tyler's municipal sewage plant worked fine with conventional methods so long as there was no oil in the refinery waste effluent. And, of course, the idea of treating domestic sewage bacteriologically has long been practiced. While showing much promise, tests there are not yet far enough along to be conclusive or permit publishing an interim report.

Among the potential advantages of microbiological methods of waste treating is the elimination or reduction of sludges. Generally there are fewer by-products requiring disposal than is the case with chemical methods. Also, once the biological process is balanced out to deliver a satisfactory effluent the amount of culture material required to keep it going may be sharply reduced. —D. P. T.

Pre-ignition Looms as the Chief Hurdle to Higher Compressions

NOT so long ago automotive engineers thought the mystery of what takes place in the cylinder during the combustion of the fuel charge had been solved through their studies of the suppression of engine knock. However, current models of higher engine speeds have brought up new fuel problems through the tendency of the charge to ignite *prior* to the passage of the spark. This form of destructive combustion is known as pre-ignition. The occurrence of pre-ignition has been called as great a hurdle to achieving higher compression ratios in automobile engines as was the phenomenon of knocking in the '20s.

"The continuing drive for more efficient utilization of gasoline has brought to the forefront another combustion problem," states one of several papers which have already been presented on this subject.(1) "It was during World War I that pre-ignition was recognized as an abnormal combustion phenomenon quite different from knock, but until recently it was critical only in high-output aircraft engines. Now, however, pre-ignition occurs extensively in high compression-ratio automobile engines, and it is at present the factor threatening to limit compression ratios. It is reported that many 'knock' complaints in recent-model engines are actually the result of pre-ignition. This means the pre-ignition resistance of fuels is assuming greater importance, and that this fuel-combustion performance factor should be taken into consideration by refiners and engine manufacturers."

In another investigation(2) to determine the occurrence of pre-ignition in present day cars in normal service, twenty-one 1952 cars of nine different makes and nine 1953 cars of six different makes were evaluated to secure information on pre-ignition and its relationship to knock. Of the nine different makes of '52 models tested, pre-ignition was detected in eight. There was a considerable spread in the resistance demonstrated by the different makes. The '53 models tested, in some cases, were improved over earlier models, while some were noticeably worse.

The information developed by these authorities is cited as evidence of the seriousness of the problem. "If pre-ignition could be eliminated or even reduced, it is conceivable that the present octane number problem might be relieved or that future engine performance gains might be made without the customary octane requirement penalty," it is stated.

Two possible fields of investigation which might relieve the problem are cited as: (1) another look by the petroleum industry at its motor fuels and lubricants (Some basic studies are called for to find out what fuel properties determine pre-ignition resistance of a fuel and how to increase this resistance), and (2) engine designers must become increasingly aware of pre-ignition, both the audible and inaudible variety, as a problem and should consider it with as much respect and ingenuity as the detonation problem has received.

The current discussion of this new combustion problem has brought into the literature a set of terms used to describe the various forms of uncontrolled combustion that occur in spark ignition engines. One author(3) has attempted to clarify these terms as follows:

Uncontrolled combustion is used in the sense of ignition of the charge which is not the direct result of the spark.

Knock is the spontaneous ignition of a portion of the end gas, as a result of its temperature and pressure, prior to the arrival of the flame which has been initiated in the rest of the charge by the spark.

Pre-ignition, a term used to cover several varieties of uncontrolled combustion, is the ignition of the charge prior to the passage of the spark.

Auto-ignition may be defined as any form of ignition which is not the direct result of the spark.

Wild ping is a condition caused by combustion chamber deposits which induce violent knock for a few cycles.

After-firing is a term used in the aircraft engine field to describe firing that occurs continuously or intermittently at full load and speed when the ignition switch is cut for a few cycles.

After-running is the continued firing at the idle condition after the ignition is turned off.

The pre-ignition problem is receiving far more attention and study by both the automotive and oil companies than did knocking when its seriousness was first recognized, which presages an earlier solution of the difficulty. —V.B.G.

(1) "Pre-Ignition in Automotive Engines," J. R. Sabina, J. J. Mikita and M. H. Campbell, E. I. du Pont de Nemours and Co., before 18th Mid-Year Meeting, API Refining Division, New York, May 14, 1953.

(2) "The Occurrence of Preignition in Present Day Cars in Normal Service," R. F. Winch, Sun Oil Co., Society of Automotive Engineers Summer Meeting, Atlantic City, June 7-12, 1953.

(3) "Uncontrolled Combustion in Spark Ignition Engines," S. D. Heron, Consulting Engineer, Ethyl Corp., Society of Automotive Engineers Summer Meeting, Atlantic City, June 7-12, 1953.

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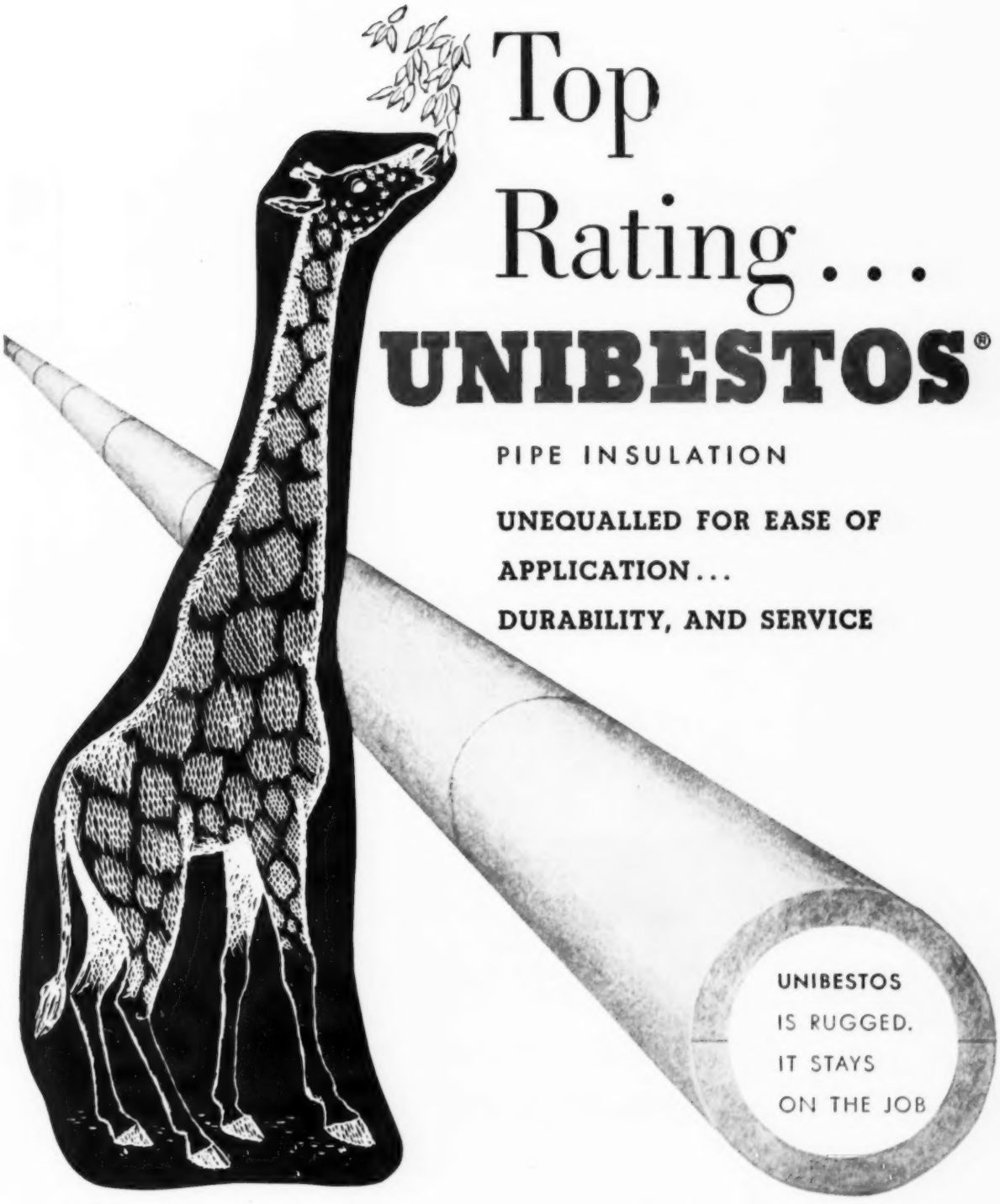

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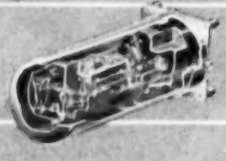

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Letters

Accent on Octanes

Your article "Accent is on Premium Octanes" [August '53, p. 1157] gives a very realistic picture of the octane situation.

As a corollary to this article, a method of expressing what these octane really mean in a car is the percent of the cars on the road whose octane requirements will be satisfied by any given octane. We worked on such figures several years ago and while we do not have access to our ultimate conclusions, they were of the order that premium gasoline would satisfy 99% of the cars on the road and that regular gasoline would satisfy 80% of the cars on the road.

The octane number to satisfy 100% of the cars on the road would be well above 100, whereas 99.9% might be satisfied with 100 . . . Similarly, just where regular gasolines of various octane would fit in such a scale would also be interesting.

We are merely passing these thoughts on to you in that we believe an article based on a study along these lines would be extremely interesting not only to the refining industry but to the automotive industry as well.

EDWIN F. NELSON
Lake Superior Refining Co.
Superior, Wisc.

Thanks, Reader Nelson, for your very worthwhile suggestion. We're following up on it.—Ed.

Underground Storage

No one here, of course, is competent to pass on the engineering details of the proposed slate-pit storage reported in PETROLEUM PROCESSING in August—"Old Quarries for Oil Storage," p. 1168. The project is admittedly in large part experimental. Only the foolhardy would try to pass prior judgment on the experiment.

Certainly, though, it is encouraging to see this attempt made to add a new kind of storage—half underground, half above-ground—to the nation's total capacity. The problem of storage is one of the most important that confronts the petroleum industry. The extraordinary demand for all products that followed the Korean invasion tended to obscure the fact that there is a tremendous seasonal swing in products demand. Now that we have returned to something closer to normal, everyone must recognize that only adequate storage can let us ride with the swing. Gasoline must

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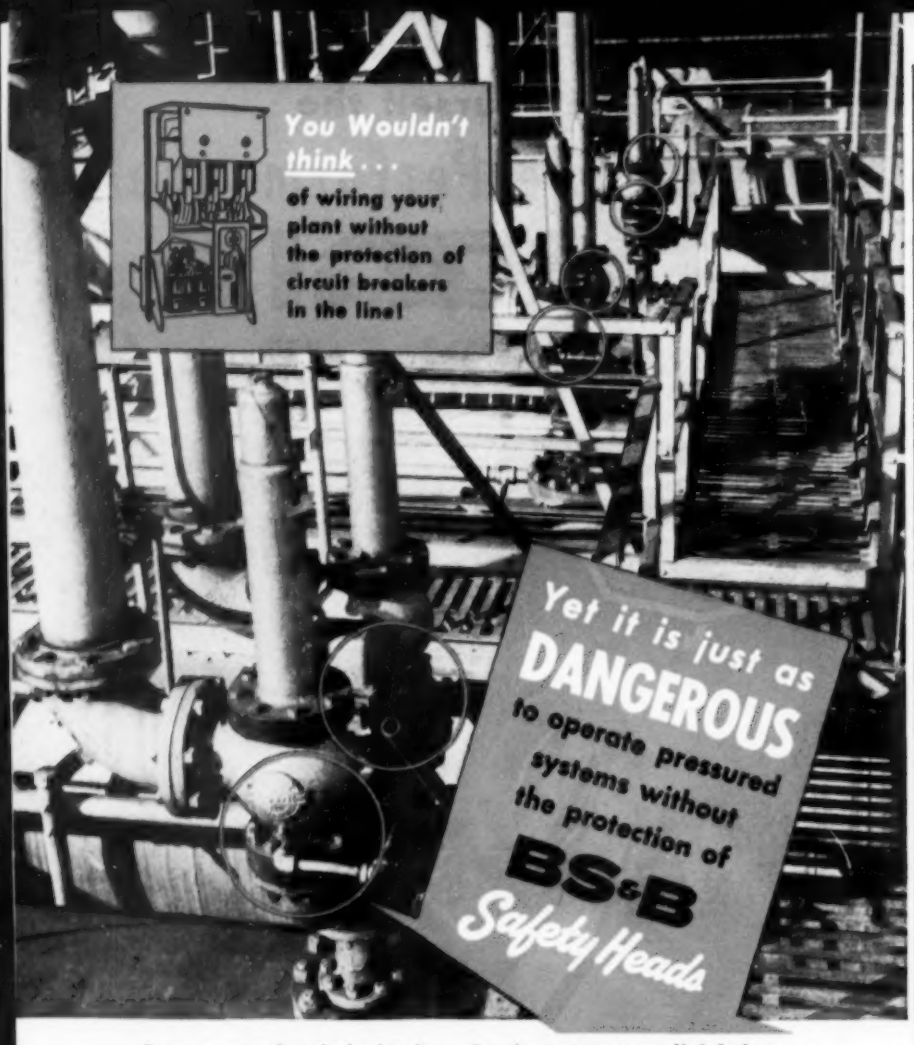
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be stored during the winter to meet the high requirements of summer driving. Fuel oil must be stored during the summer to meet the high requirements of the heating season. That seems elementary, but it is a point that too often has been overlooked by some people in the industry.

In my official capacity as Deputy Administrator, I am recommending to the Government—especially the military—an intensive study of underground storage. Such storage will, I am sure, prove safer and, in many cases, more economical than the admittedly expensive storage in steel tanks above-ground. It will decrease the deterioration of product that comes in above-ground storage, and it will provide a part of the margin of safety on petroleum that we need so badly.

The liquefied petroleum gas part of the industry already is making great progress in this sort of storage. Admittedly there are many problems still to be solved, but I think the first firm steps forward already have been taken. Within the next several years we should overcome every technical difficulty.

JOSEPH A. LAFORTUNE
Deputy Administrator
Petroleum Administration for Defense
Washington 25, D.C.

Too Many Bosses?

I read with some interest the article in your July issue on "Selecting the Best Supervisors," (pp. 1013-1016), which reports an interview with Mr. Radom of Standard Oil Co. (N.J.).

The thing that impresses me is that Standard Oil Co. has no "poor" supervisors; they are all "best." They apparently have a "most best" and a "least best."

If, in order to preserve the tradition that Standard Oil Co. has only the best, Mr. Radom is willing to indulge in a grammatical travesty like "least best," I would like to suggest that he adopt the following classifications:

1—Best Best.
2—Better Best.
3—Good Best.
4—Fair Best.
5—Best.
6—Poor Best.
7—Bad Best.
8—Worse Best.
9—Worst Best.

"WRIGHT G. RAMMAR"

• *Touché!*
Radom's grammar's wrong.
"G.rammar's" grammar's (W)right.

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October ★ One of a Series of Interest to the Petroleum Industry ★ 1953

A Million $ a Week for Research

Du Pont spent $52,000,000 for its research program last year. And this sum was exclusive of construction costs for new research facilities.

In spite of its high cost, the Du Pont Company believes research offers the best assurance for long-range job security. New job opportunities are created through the new products it develops.

It also helps to create new market opportunities for many basic raw materials. Petrochemicals are an outstanding example of this and Du Pont buys increasingly larger quantities of them every year.

Du Pont Research Program to Help Refiners Solve Pre-Ignition Problems

Pre-ignition during road operation is a definite obstacle to further improvement in the efficiency of fuel utilization in gasoline engines.

The development of higher compression engines makes the need for a solution to this problem—which possibly exceeds knock in importance—all the more pressing. With the aim of helping refiners overcome pre-ignition through the use of additives, the Du Pont Petroleum Laboratory has already done extensive research.

The laboratory has found that the two most important aspects of the problem are: (1) the tendencies of combustion chamber deposits to glow and cause surface ignition of the charge; and (2) the ability of fuels to withstand ignition by hot surfaces.

Deposit glow can be minimized by certain fuel additives. With future higher compression ratio engines it may also be necessary to improve the ability of fuels to withstand hot surface ignition.

EFFECTIVENESS OF TEL

Glowing deposits, principally those flaky in nature, act as igniters and some hydrocarbons are more sensitive to ignition by these hot deposit particles than others.

However, by raising the octane rating as for example *with tetraethyl lead, the pre-ignition tendency of the gasoline is reduced.*

"Magic Barrel"

40 OUTSTANDING PRODUCTS DERIVED FROM PETROLEUM MAKE UNIQUE PUBLIC RELATIONS PRESENTATION

The "Magic Barrel" *looks* like a 55-gallon oil drum.

But, instead of crude oil, the drum contains a wide variety of *finished* products made from petroleum . . . products used every day in the home, on the farm, in industry and on the highways. All of these have been woven into a unique presentation that shows the tremendous importance of petroleum in our daily living.

PETROLEUM is the important ingredient in all the products shown in this "Magic Barrel" display. Mounted on semi-circular trays, the whole display is built up out of the oil drum in the center.

The display and the talk accompanying it were put together by the Du Pont Petroleum Chemicals Division. The show was designed, however, to be used by oil industry representatives, as a public relations presentation. It is both entertaining and educational. As such it is ideally suited for showings to schools and colleges, civic organizations and luncheon clubs, as well as to employee and customer groups.

More complete details on these investigations by the Du Pont Petroleum Laboratory can be obtained from any Du Pont Petroleum Chemicals Division district office. Ask for papers entitled "Pre-Ignition in Automotive Engines" and "An Investigation of Pre-Ignition in Engines."

FLEXIBLE PROGRAM

The speaker builds his theme of "better living from petroleum products" by displaying and demonstrating the many interesting products found in the barrel. The talk is extremely elastic and can be done in 30 minutes or extended to an hour.

The barrel itself is made of aluminum and split lengthwise into two sections. These are hinged together so that the drum can be opened and used as a lectern by the speaker. There are 16 removable shelves inside the barrel. Each holds a small display of related products. Products can be changed or added at the will of the speaker.

3 BASIC NEEDS

The presentation covers the three es-

OVER

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

PETROLEUM CHEMICALS DIVISION
NEWS

CONTINUED *"Magic Barrel"*

sential needs for living: food, clothing and shelter. Protective wrappers, refrigerants, insecticides and weed killers, for example, are all important to food production and distribution.

INSIDE THE "MAGIC BARREL," the trays of products are compactly arranged for convenient shipping.

Synthetic fibers, of course, play an important role in our modern clothing industry. And there are numerous plastics, paints, upholsteries, brushes and

MAKING SYNTHETIC RUBBER right on top of the barrel adds a unique touch of showmanship to the presentation.

other products made from petroleum which are used every day in the home and are included in the display.

The "Magic Barrel" is even a *factory* for making synthetic rubber. Starting with a liquid polymer, rubber balls are produced in a matter of seconds. These are tossed out to the audience as souvenirs.

AVAILABLE TO YOU

If you would like to make use of this presentation in your own public relations program, just get in touch with the nearest Du Pont Petroleum Chemicals Division district office.

Sales-Service Representative

ARTHUR C. SANTORA joined the Du Pont Company in 1950 as a sales-service representative of the Petroleum Chemicals Division's eastern district.

His association with the petroleum industry began in 1943 as a research engineer for the Standard Oil Development Company. During the next seven years his work included research on polymerization, hydrocarbon synthesis, inhibitors, aviation gasoline and a wide variety of petroleum refining problems.

A graduate of Union College with a B.S. in chemistry, Mr. Santora received his M.S. in physics from Cornell in 1940 and his Ph.D. in organic chemistry from the University of North Carolina in 1943. He has also taught mathematics, mechanics and analytical chemistry.

He is a member of the American Chemical Society and the Society of Automotive Engineers.

ARTHUR C. SANTORA

Additive to Improve Diesel Fuels

Du Pont Fuel Oil Additive No. 2, originally developed as a stabilizer and dispersant for distillate fuel oils used in domestic oil burners, also offers a number of advantages to diesel fuel refiners.

Being ashless, it leaves no combustion chamber deposits to cause operating difficulties.

To help refiners gain added flexibility and capacity in diesel fuel production, Fuel Oil Additive No. 2 enables them to blend cat-cracked and straight-run stocks. This additive also allows a certain amount of heavy oil to be blended in the diesel fuel without giving undue difficulties with filterability. In this way, it enables refiners to upgrade their heavy fuel oils.

To prevent clogging of diesel filter screens, Fuel Oil Additive No. 2 not only retards the formation of insoluble residues, but also reduces the particle size of those insoluble residues that are formed.

Storage tests show that in all cases Fuel Oil Additive No. 2 gives best results when added at the refinery to freshly prepared stocks.

LITERATURE AVAILABLE

Here is a partial listing of the bulletins, reports, booklets, technical papers and aids available to you through any of the Du Pont Petroleum Chemicals Division district offices listed below:

Pre-Ignition in Automotive Engines—This paper discusses mainly the glowing tendencies of combustion chamber deposits and the pre-ignition tendencies of individual hydrocarbons . . . . . Serial A-5632

An Investigation of Pre-Ignition in Engines—A comprehensive discussion of how compression ratios and other mechanical factors affect pre-ignition. Also the effect of tetraethyl lead in reducing pre-ignition . . . . . Serial A-5756

Du Pont Fuel Oil Additive No. 2—A 12-page bulletin describing this ashless stabilizer and dispersant which prevents clogging of fuel oil screens. . Serial A-5201

DU PONT

Better Things for Better Living . . . through Chemistry

Petroleum Chemicals

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
Petroleum Chemicals Division • Wilmington 98, Delaware

District Offices:
NEW YORK, N. Y.—1270 Ave. of the Americas — Phone COlumbus 5-3620
CHICAGO, ILL.—8 So. Michigan Blvd. — Phone RAndolph 6-8630
TULSA, OKLA.—1811 So. Baltimore Avenue — Phone Tulsa 5-5578
HOUSTON, TEXAS—705 Bank of Commerce Bldg. — Phone PRestan 2857
LOS ANGELES, CALIF.—612 So. Flower St. — Phone MAdison 1691

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ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

A-6108

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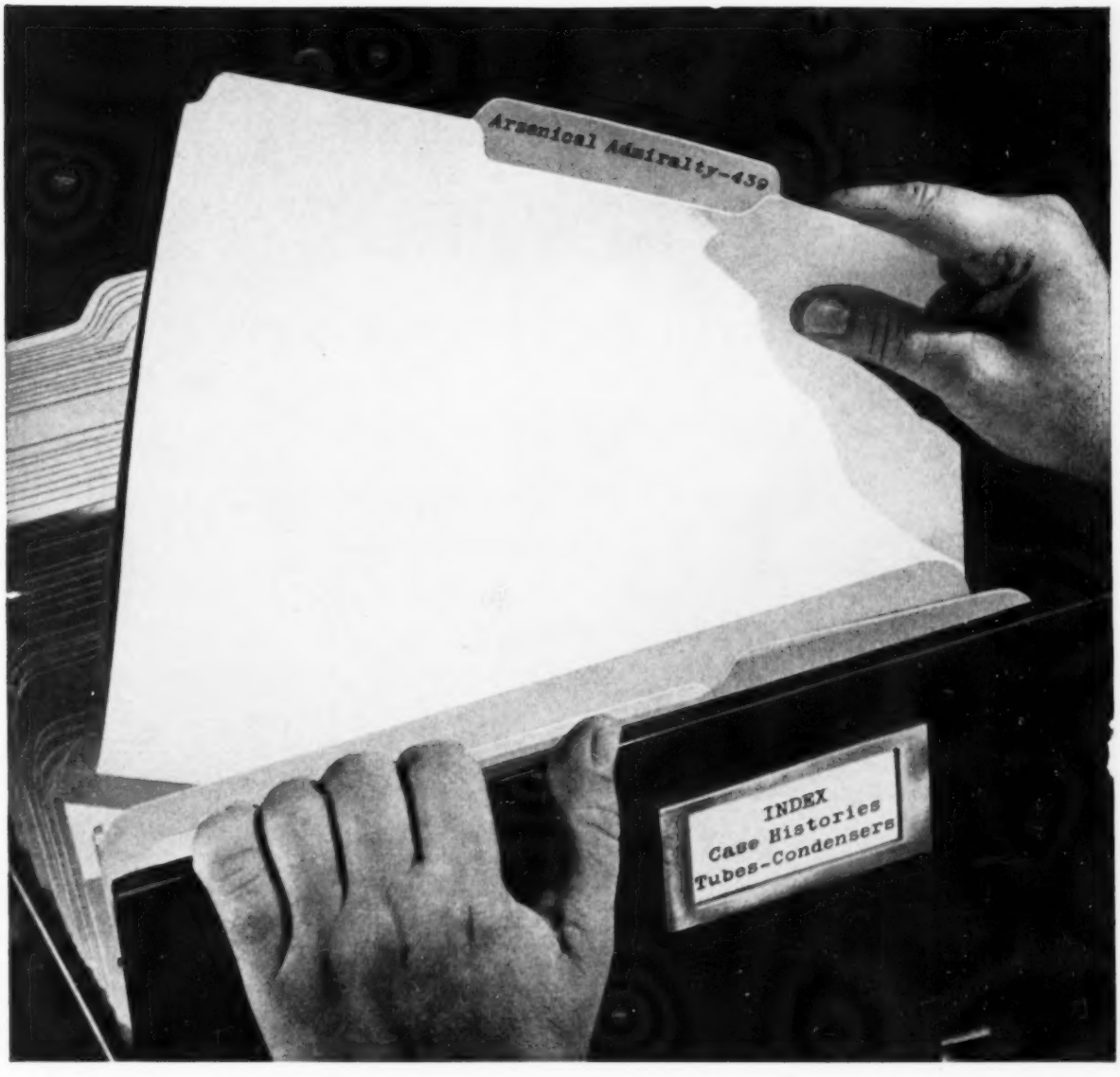


The least costly tube experience is somebody else's

AS fabricators of heat exchanger tubes, we are vitally interested in the science of metallurgy and the insight which it provides into the nature and behavior of metals. But we are equally interested in the practical evidence of actual performance.

Sound as it is to be guided by scientific principles in selecting a heat exchanger tube alloy—it's also necessary and desirable to profit by experience. That's why, in addition to our extensive metallurgical research and our programs of laboratory and field tests, we maintain files that record over many years the life histories of all types of tubes under all kinds of actual operating conditions. These records of experiences are the unchallengeable test of the soundness of theory.

This experience is yours to draw on in connection with any heat exchanger tube problem. And it's experience that costs you nothing. Just write to our Technical Department. 5818

ANACONDA®
Heat Exchanger Tubes

Ambraloy-927*; Arsenical Admiralty-439, Cupro Nickel, 30%-702, and other copper alloys

*U. S. Patent No. 2,003,685 (Orig.)

The American Brass Company, Waterbury 20, Conn.
(In Canada: Anaconda American Brass Ltd., New Toronto, Ontario)

Send me Publication B-2 "AnacondA Tubes and Plates for Condensers and Heat Exchangers"

NAME .....

COMPANY .....

STREET .....

CITY ..... ZONE ..... STATE .....

(To obtain more data on advertised products see page 1584)

Advertisement

Which of these BASIC MATERIALS will solve *your* processing problems?

Norton electric furnace products are engineered and prescribed to meet many manufacturing needs

Backed by over 50 years of experience in electrochemical refining, Norton brings you basic materials whose purity and properties are carefully controlled and consistently duplicated.

These Norton electric furnace products differ greatly in composition and characteristics. They are the source of the many Norton *engineered prescriptions* which have proved of immense practical value in widely varying processes.

Moreover, each of them has possibilities for use which are still undiscovered. It will pay you, therefore, to read the following descriptions very carefully. Even this partial list may contain the exact combinations of properties *you* need.

ALUMINUM OXIDE (ALUNDUM®)

Norton is the world's largest producer of this basic material — fused alumina. *Characteristics:* high melting point, about 3700°F; specific gravity, 3.95; good chemical stability, neutral to most chemical reagents; extreme hardness of 2000 Knoop, with great toughness; reasonably high thermal conductivity, 2½ times that of fire clay; high dielectric strength. *Uses:* heavy refractory furnace shapes; pure oxide and sintered refractories; radio tube insulation; porous media for filtration and diffusion; catalyst carriers and fluid catalysts; heat exchange pebbles; wear-resistant parts; laboratory ware.

SILICON CARBIDE (CRYSTOLON®)

Silicon carbide is produced by Norton in large tonnages. *Characteristics:* high melting point, disassociates at about 4175°F; specific gravity, 3.20; extreme hardness of 2500 Knoop, with excellent abrasion and erosion resistance; high thermal conductivity, 7 to 10 times that of fire clay; excellent resistance to thermal shock; maintains great strength to very high temperatures (PCE, 3350°F — cone 37 to 40); unique electrical qualities; relatively low thermal expansion; no inversion on heating; chemically acidic, with good stability. *Uses:* special refractories for boiler furnaces, ceramic kiln furniture, heat treating, hearth plates, high thermal conductivity muffles and retorts; electrical heating elements; lightning arrestors; metallurgical additions; also available in a Norton-patented process for coating graphite — in rocket nozzles and reaction motor parts, etc. — for increased resistance to erosion by high velocity gases.

MAGNESIUM OXIDE (MAGNORITE®)

Fused magnesia of highest purity. *Characteristics:* extremely high melting point, about 5,000°F; specific gravity, 3.58; electrical resistivity, 10^8 ohm cm at 1000°C; chemically basic. *Uses:* linings for metal melting furnaces; high temperature electrical insulation; refractories for handling corrosive caustic materials.

FUSED STABILIZED ZIRCONIA

Norton was the first to develop fused zirconia for practical commercial use. *Characteristics:* high melting point; thermal conductivity in British Units at 2000°F is 6.2 for dense shapes, 4.7 for insulating shapes, 2.8 for insulating grain; high resistance to abrasion and thermal shock; not wet by most molten metals; changes from a fairly good electrical insulator at low temperature to a conductor at 1000°C. *Uses:* refractories for extremely high temperatures; setter plates for titanates; furnace linings for high temperature gaseous chemical reactions; zirconium chemicals; metal melting furnace linings; catalyst carriers; heat exchange pebbles; reaction engine parts including jet and rocket liners.

BORON CARBIDE (NORBIDE®)

The hardest man-made material, an exclusive Norton development of boron carbide. *Characteristics:* high melting point, 4440°F; specific gravity, 2.50; compressive strength, 414,000 psi; bending strength, 44,000 psi; self-bonding, unaffected by all acid and alkali solutions. *Uses:* abrasive for economical replacement of diamond dust in lapping; high purity powder of micron sizings for use as refractory and in "cermet" combinations; neutron absorption in nuclear reactors or particle accelerators; pressure-blast nozzles; wearproof bushings, slides, etc.

In these Higgins type arc furnaces tremendous amounts of electrical energy are utilized by Norton in electrochemically refining crude minerals into basic Rx refractory materials.

BORON NITRIDE

Refined by Norton to over 98% purity. *Characteristics:* melts or dissociates at 5400°F; a nonconductor of electricity; weighs only 7 lbs. per cu. ft.; is not oxidized in air at 1200°F. *Uses:* anti-sticking agent for use with molten glass or metal; heat-resistant lubricant; thermal insulator in vacuum or atmosphere furnaces; experimental refractory or crucible material; experimental electrical insulator.

MANY OTHER MATERIALS

Among the high-melting, useful materials made available by Norton are Special Fused Oxides, Refractory Carbides, Refractory Borides, Mixed Borides, Elemental Boron. Research, development and field testing are being conducted on Experimental Borides, Carbides, Nitrides and Silicides. Some of these are in regular industrial use and new uses are being found for others.

AVAILABLE IN MANY STANDARD OR SPECIAL FORMS

Besides supplying these materials in their crude form, more or less as they come from the furnace, Norton has extensive facilities for processing and fabricating — and is ready to work with you in engineering any of these materials to your particular requirements.

GET THIS BASIC MATERIALS BOOKLET

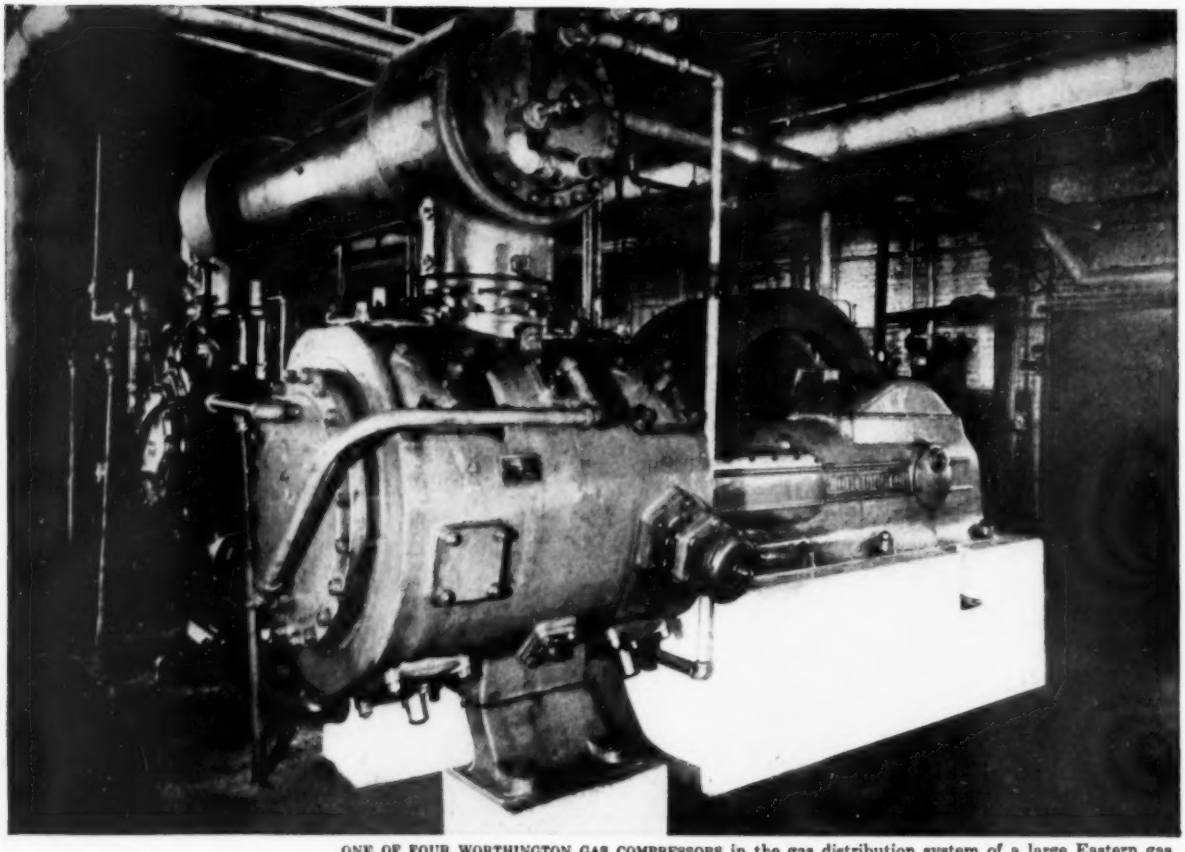
This new Norton Publication, "Basic Materials," contains 22 pages of detailed information, including actual and suggested uses. For your copy, write to NORTON COMPANY, 269 New Bond St., Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.

NORTON
Rx REFRACTORIES

Making better products . . . to make other products better

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

(To obtain more data on advertised products see page 1584)



ONE OF FOUR WORTHINGTON GAS COMPRESSORS in the gas distribution system of a large Eastern gas company. Compressor is positive displacement reciprocating type with capacity of 125,000 standard cu ft of manufactured gas per hour. Maximum discharge pressure is 100 psi. Volume is controlled by Worthington's automatic variable capacity control.

When a large Eastern gas company needed another gas compressor...

...There was no question about which make should be selected!

The gas compressor in the picture had been working so well since 1949 that Worthington was the logical choice for the *next* new compressor to handle expanded capacity.

These Worthington features constantly increase the number of such choices:

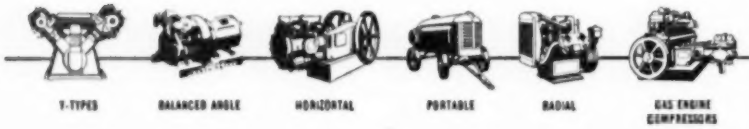
Accurate control of volume that is always assured with Worthington's automatic variable capacity control — acknowledged most accurate, flexible and simple control obtainable.

Worthington's exclusive Feather Valve* — simplest, lightest, most efficient ever made—eliminates valve problems. And Worthington's high-efficiency intercooler needs less water, less power, less attention.

Somewhere in the broad line of Worthington compressors, for air, gas or other "compressables", there is the one right type and size for your job. *Worthington Corporation, Compressor Division, Buffalo, N. Y.*

*Reg. U. S. Pat. Off.

K.2.15



No Other Compressor Will Outperform a Worthington

WORTHINGTON

Compressors

take a closer look at

TEMPERATURE PRESSURE CORROSION

Periodic review of your operating requirements pays dividends when you discover the *best* alloy tubing for your own specific needs. B&W's wide range of intermediate alloys are being used extensively in a variety of high temperature services. All have earned universal acceptance and praise for giving optimum service satisfaction with economy over the years. The accompanying table shows the extensive range of temperature, pressure, corrosion and oxidation conditions met by B&W Alloy Tubing. Detailed technical data is contained in Bulletin TB-6, available upon request. Mr. Tubes—your B&W Tube Representative—will be pleased to discuss tubing technics with you.

CARBON-MOLY —0.50% Mo—For services to 1050F requiring higher creep strength than carbon steel with no increase in corrosion or oxidation resistance.

CROLOY ½ —0.60% Cr, 0.50% Mo—For operating conditions to 1075F requiring properties superior to carbon-moly with respect to graphitization and creep strength.

CROLOY 1¼ —1.25% Cr, 0.50% Mo—Economic grade good creep strength properties up to 1100F. Somewhat more corrosion resistant than chromium-free steels.

CROLOY 2 —2% Cr, 0.50% Mo—Economic grade for resisting both oxidation and corrosion, with excellent high-temperature strength, up to 1150F.

CROLOY 2¼ —2.25% Cr, 1.00% Mo—Exceptionally high creep strength up to 1175F for polymerization and high pressure cracking. Otherwise similar in properties and characteristics to Croloy 2.

CROLOY 3-M —3% Cr, 0.90% Mo—Somewhat better creep properties, and resistance to corrosion and oxidation up to 1175F than Croloy 2.

CROLOY 5 —5% Cr, 0.50% Mo—For operating conditions up to 1200F where corrosion resistance is a primary requirement—with creep strength and oxidation resistance superior to Croloy 2.

CROLOY 5-Si —5% Cr, 0.50% Mo, 1.50% Si—for operating conditions up to 1300F where oxidation resistance is a primary requirement. Excellent resistance to scaling under straight oxidizing conditions.

CROLOY 7 —7% Cr, 0.50% Mo—For operating conditions up to 1250F where corrosion resistance is the primary requirement. Somewhat more oxidation resistant than Croloy 5.

CROLOY 9-M —9% Cr, 1% Mo—For severe operating conditions up to 1300F where high corrosion and oxidation resistance are essential as in hydrogenation processes.

Steels from CROLOY 1¼ upward are electric furnace alloy steels which are normally cleaner and of better quality than open hearth steels. This contributes to greater reliability and improved creep properties at elevated temperatures.

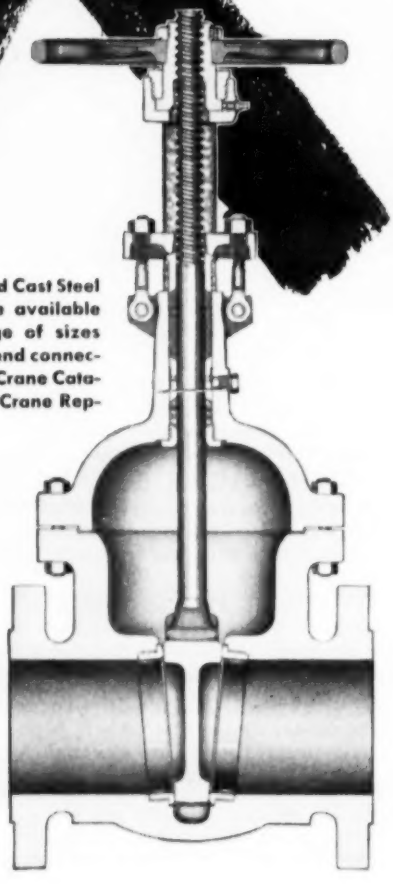
THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing

B&W SEAMLESS and WELDED TUBES

TA-1793 (F)

X Marks a BIG Difference

IN 300-POUND STEEL GATE VALVES



Crane 300-Pound Cast Steel Gate Valves are available in a wide range of sizes with 3 different end connections. See your Crane Catalog or call your Crane Representative.

There's a lot of pioneering wrapped up in Crane 300-Pound Cast Steel Wedge Gates—pioneering that helped set the high quality standards every modern steel valve must meet.

Take Crane *Exelloy*—"X" trim—for example. In the early days of oil refining, many metal and metal combinations were tried for seating surfaces and found wanting. Crane *Exelloy*, adopted more than 25 years ago, set a new record of usefulness and satisfaction. So remarkable was its performance that this class of material (roughly designated as 11½ to 13 per cent chrome) became the recognized staple valve trim in the petroleum industry.

And yet, Crane still manages to come up with "X" trim of superior quality. It's done with bars and billets that meet the most rigid specifications—and manufacturing techniques that develop the best characteristic of material for each component part.

And it's you, the Thrifty Valve Buyer, who benefits from Crane Co.'s pioneering experience. You get better quality steel valves—quality that keeps up performance and holds down maintenance costs.

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

FOAM FACTS

Published quarterly in the interests of fire protection everywhere.

NATIONAL FOAM SYSTEM, INC.

WEST CHESTER, PENNA.

Quality Control in Every Step Assures Safe, Fire Blanketing Foam

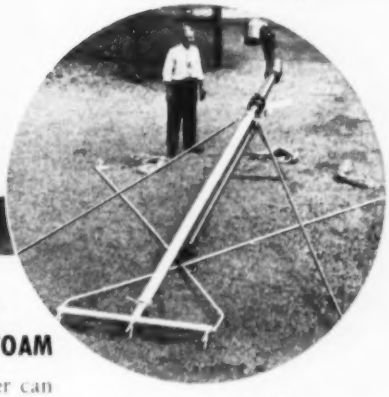
There's a difference in foam. Not all foam is good foam for the extinguishment of flammable liquid fires. Bubble size and stability are important and photomicrographs disclose major variations in foams of differing manufacture.

A rigid system of "quality control" in every step of manufacturing assures the right foam in National Aer-O-Foam. Photomicrographs of National Aer-O-Foam show a mass of uniformly small bubbles tightly knit in an unbroken blanket of fire-smothering foam that has long lasting stability.

There is a reason for this consistent, dependable quality. National Foam System controls every step of the manufacture of its foam in its own plants. Every one of the more than a dozen chemicals are pre-tested for peak quality and re-tested during processing. Finished products are then Fire-Tested for actual performance. When you buy National Aer-O-Foam you are certain of quality and Fire-Tested Protection.

NEW FOAM TOWER SAVES MANPOWER, SPEEDS TANK PROTECTION

Compact, needs Only Four Men To Operate



A new portable foam tower raised and lowered by hydraulic action is now available. It can be set up in a fraction of the time formerly needed and with one-third the manpower. The same tower may be used for tanks of different heights and can easily be converted for use with chemical foam.

Quick dependable hydraulic action, which can be applied at a safe distance from the fire, raises the tower to full height in a matter of seconds. When it is elevated to a point above the upper edge of the tank wall, pressure is released and the tower gradually descends until the gooseneck is hooked over the edge of the wall. All of this is achieved hydraulically with a minimum of manpower and with less pressure than necessary for the foam system itself. Each tower is equipped with National Foam's exclusive Selective Orifice Foam Maker. Write for new data sheet 653-3-A.

QUICK CHANGE UNIT PROPORTIONS DRENCH OR FOAM

A new National Proportioner can be used either for Aer-O-Foam Liquid or National's penetrating wetting-agent, Drench. Its quick changeover feature allows fire to be brought under control with a blanket of foam and the surrounding area to be wet down to contain the fire.

The prolonged dry spells of this summer have given fire fighters the opportunity to learn about the quick effectiveness of Drench. Used as a wetting agent on Class A fires, a 1% Drench solution effects a 40% to 70% reduction in both the extinguishing time and the amount of water used.

By simple valve adjustment either Drench or Aer-O-Foam can be quickly proportioned in this new National Proportioner.

Get Your Copy of FOAM FACTS

For interesting facts and data on fire protection let us mail you FOAM FACTS Quarterly. Send in your request.

(To obtain more data on advertised products see page 1584)

write your music for Quartet

IN THE PETROLEUM PROCESSING INDUSTRIES

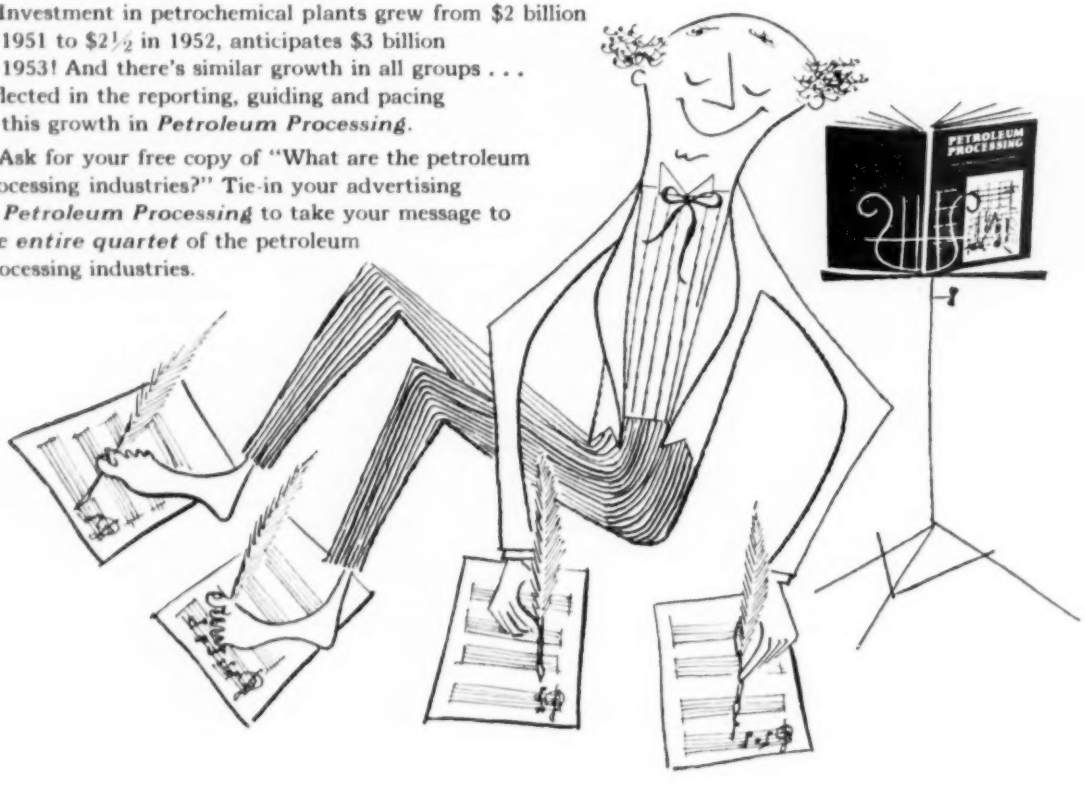
Solos are grand in a concert, but to have the petroleum processing industries singing the praises of your product, you need *an arrangement for quartet!*

There's one arrangement for your advertising which reaches all four important areas of this great industrial group. It's called ***Petroleum Processing;*** it goes directly, effectively, forcefully to all four groups:

1. Petroleum refining.
2. Petrochemical manufacturing.
3. Natural gasoline recovery.
4. Lube oil blending and compounding.

Investment in petrochemical plants grew from $2 billion in 1951 to $2½ in 1952, anticipates $3 billion in 1953! And there's similar growth in all groups . . . reflected in the reporting, guiding and pacing of this growth in ***Petroleum Processing***.

Ask for your free copy of "What are the petroleum processing industries?" Tie-in your advertising in ***Petroleum Processing*** to take your message to the ***entire quartet*** of the petroleum processing industries.



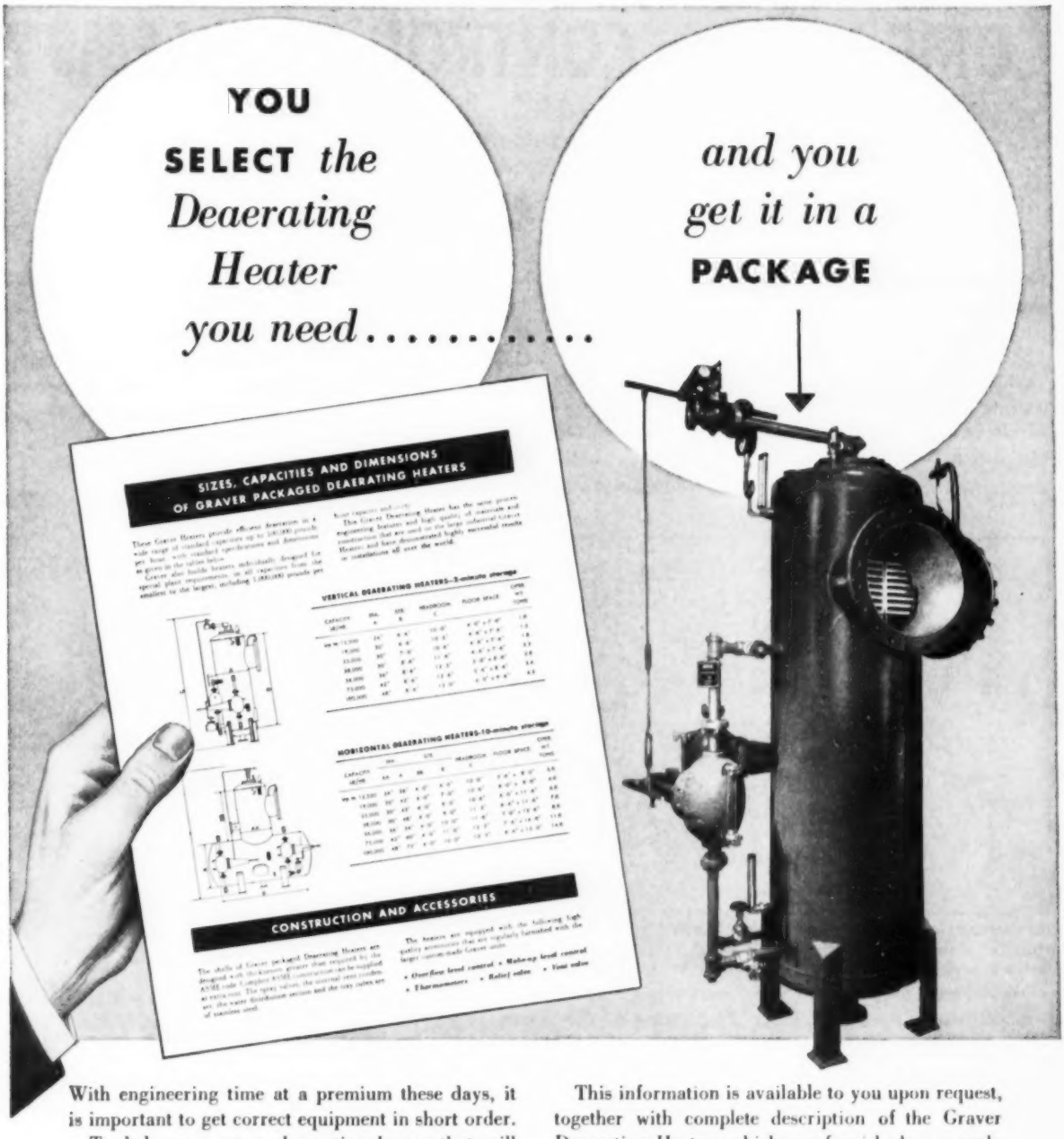
PETROLEUM PROCESSING

A McGraw-Hill Publication

Publication office:
1213 West Third Street
Cleveland 13, Ohio

YOU SELECT *the Deaerating Heater you need.....*

and you get it in a **PACKAGE**


SIZES, CAPACITIES AND DIMENSIONS
OF GRAVER PACKAGED DEAERATING HEATERS
VERTICAL DEAERATING HEATERS—3-minute storage
HORIZONTAL DEAERATING HEATERS—10-minute storage
CONSTRUCTION AND ACCESSORIES

With engineering time at a premium these days, it is important to get correct equipment in short order.

To help you get a *deaerating heater* that will exactly meet your needs, Graver has developed charts and data sheets that give complete engineering, selection and dimensional information for a wide range of heater capacities.

This information is available to you upon request, together with complete description of the Graver Deaerating Heaters which are furnished as a package . . . with all internal parts, controls, valves and instruments you need for the installation. Your request for this information will not involve the slightest obligation on your part.

GRAVER WATER CONDITIONING CO.

Division of Graver Tank & Mfg. Co., Inc.

DEPT. PP-PH 216 WEST 14TH STREET, NEW YORK 11, N. Y.

In Canada: The Bird-Archer Co., Ltd., Cobourg, Ontario • In Mexico: Proveedores Tecnicos, S.A., Puebla 259, Mexico 7, D. F.

GRAVER Deaerating Heaters

Advertisement

COMPRESSOR CONTROL PROBLEMS?

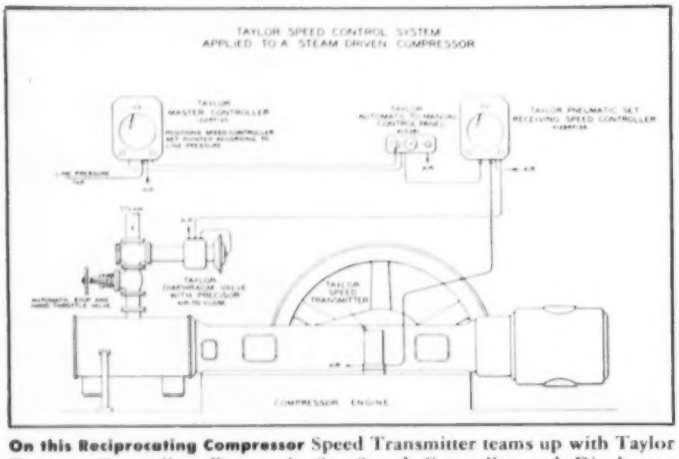
Taylor Speed Control gives better operating economy and processing quality for any type compressor or driver

Taylor Compressor Control Systems combine speed control to give you fully automatic control of compressors with direct relation to other variables in your process. These compressor control systems were developed by Taylor Engineers working hand in hand for years with leading compressor manufacturers and the ultimate user in refineries, gasoline plants and petro-chemical plants.

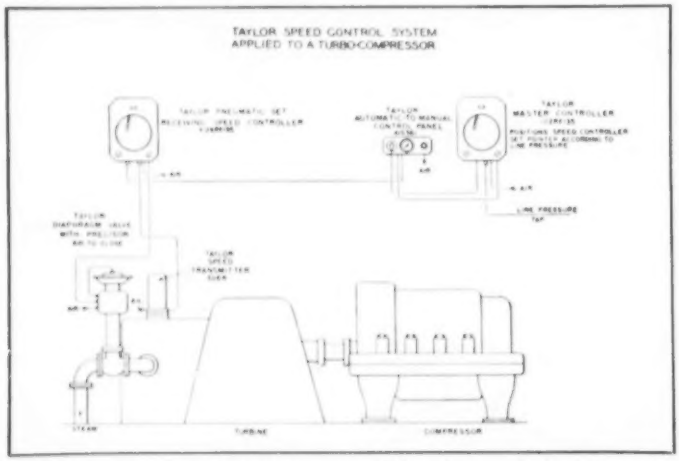
This all adds up to one important point. *When a compressor's function is closely controlled according to process requirements, substantial economies result from reduced fuel consumption as well as higher yields of quality end product.*

We can furnish a rugged, dependable control system for any type of driver and compressor combination. Ask your Taylor Field Engineer! Or write Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.

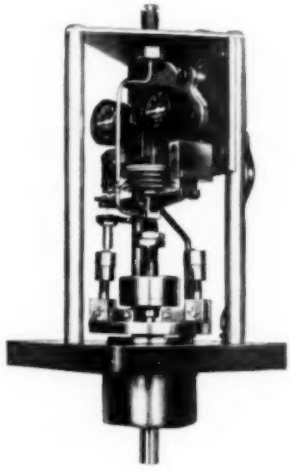
Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.



On this Reciprocating Compressor Speed Transmitter teams up with Taylor Pressure Controller, Pneumatic Set Speed Controller and Diaphragm Valve to maintain desired process pressure at minimum operating cost.



Applied to a Centrifugal Compressor equal benefits are derived from this control system. Fuel consumption is held to a minimum, consistent with the maintenance of optimum process pressure.



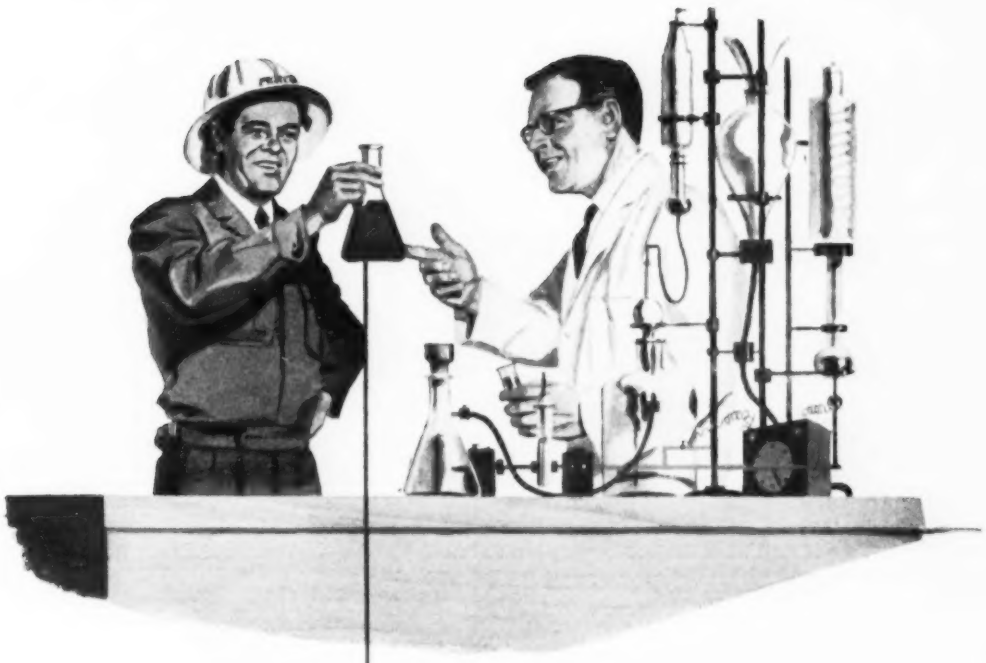
Taylor Speed Transmitter permits use of standard controls!

Here's how it works:

It is a dependable force-balance transmitter working in combination with a Taylor FULSCOPE* pneumatic controller. The fly-ball operated transmitter is driven by the compressor and converts engine speed directly to output air pressure proportional to the square of the speed. This signal is received by a Pneumatic-Set FULSCOPE Controller which regulates the fuel valve to give desired speed control. Processing pressure requirements—measured and controlled by the master controller—determine the speed controller set point.

*Reg. U. S. Pat. Off.

TAYLOR INSTRUMENTS MEAN ACCURACY FIRST



improve YOUR products with

PERCO*

How will your products stand up against competition one, two or three years down the road?

After analyzing that problem, a good many refiners have found the answer in a Perco process. At a reasonable investment cost per barrel of charge and remarkably low operating expense, Perco enables you to upgrade your products in line with the current and anticipated market demands.

When you are considering a Perco process, arrangements can be made to evaluate samples of your present or proposed feed streams under actual operating conditions in Perco pilot plants.

Over 130 installations licensed by Perco throughout the United States, Canada and Latin America prove the wide application of Perco processes to current refining problems.

Now is the time to upgrade your throughput.

Write Perco today for full information.

PERCO *Division*

Phillips 66

PHILLIPS PETROLEUM COMPANY

PERCO®
*A SERVICE MARK

Bartlesville, Oklahoma

(To obtain more data on advertised products see page 1584)

Get

something extra

when you buy

lead valves

Do you look for sturdiness, dependability, and suitability in the lead valves you buy?

Do you expect valve type, size, pattern and flanging to meet your acid handling equipment specifications?

Of course you do! And when you order National you *get* what you look for. You *get* what you expect. And you get certain "extras" besides... extras that spell highest quality.

For example, the lead used is the grade acknowledged best for acid-handling – St. Joe Chemical Lead. Furthermore, National Lead valves have precision, lathe-turned stems. They have full flow-ways. They're designed to permit repacking in service. And they have positive plug-seat fit.

Fabrication extras... design extras... quality extras... Yes! And these extras you get, but never need specify, add up to outstanding service on the job.

That's why it pays to buy National valves ... for something extra in lead.

New York 6; Atlanta; Baltimore 3; Buffalo 3; Chicago 8; Cincinnati 3; Cleveland 13; Dallas 2; Philadelphia 25; Pittsburgh 12; St. Louis 1; New England: National Lead Co. of Mass., Boston 6; Pacific Coast: Morris P. Kirk & Son, Inc., Los Angeles 23, Emeryville 8 (Calif.), Portland 10, Seattle 4; Canada: Canada Metal Co., Ltd., Toronto 8, Montreal, Winnipeg, Vancouver.

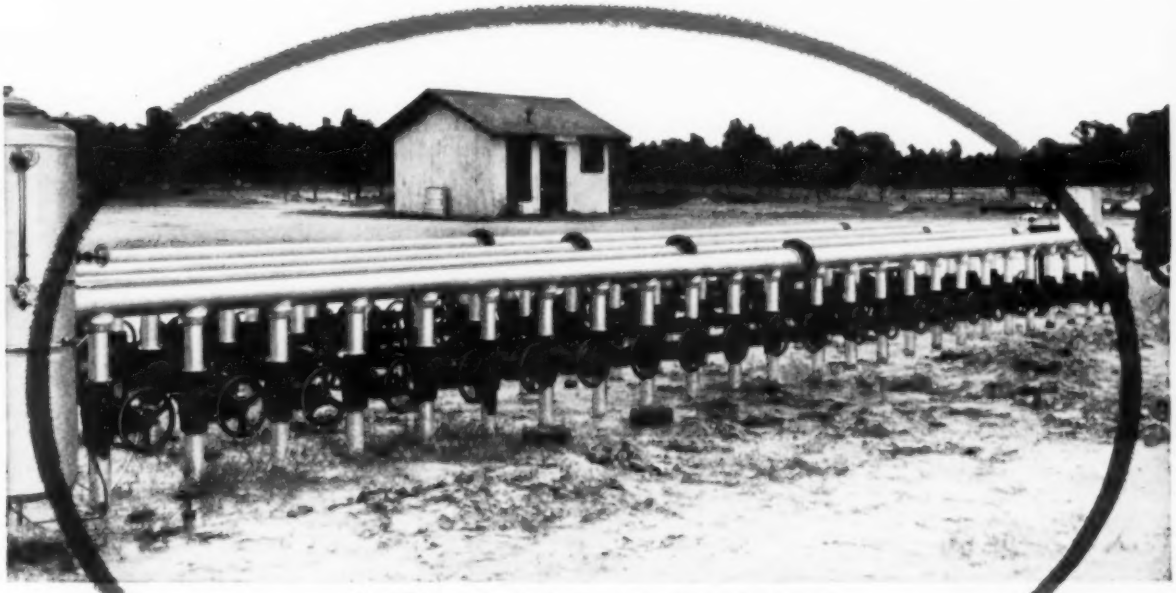
* Reg. U. S. Pat. Off.

Lead valves

with a NATIONAL reputation

LEAD COMPANY

BOOST YOUR PRODUCTION with THREDOLETS and SOCKET WELDOLETS!

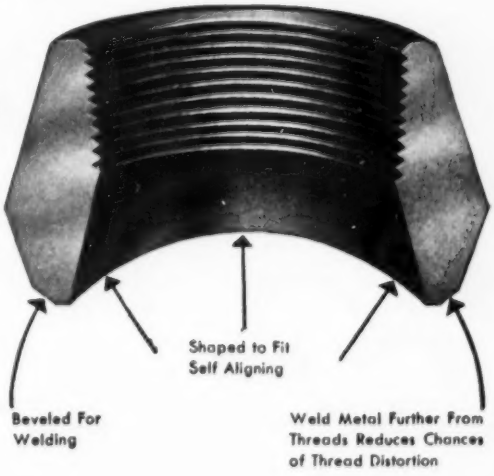


ThredOlets at work in L. P. Gas Plant Production Separators. 4" x 2" ThredOlets utilized for branch connections on manifolds subjected to contraction, expansion and vibration. The ThredOlet's short height and wide footing creates rugged branch construction.

141-5

Insure production economy in pipe fabrication through the *exclusive* features *engineered* and *manufactured into* ThredOlets and Socket WeldOlets. Production is boosted because you weld *more pieces* per hour!

Instant application and immediate availability will save you time, labor and money in constructing all 90° Threaded and Socket-weld branch connections.



SPECIFY AND USE...
BONNEY THREDOLETS & SOCKET WELDOLETS

ThredOlets

Socket WeldOlets

FOR COMPLETE ENGINEERING DATA WRITE FOR YOUR BONNEY W-3 WELDOLET CATALOG
DISTRIBUTORS IN PRINCIPAL CITIES

WELDING FITTINGS DIVISION
BONNEY FORGE & TOOL WORKS
ENG. DEPT., 368 GREEN STREET
ALLENTOWN, PENNSYLVANIA

prelude to a partnership

When a petroleum refiner decides to do business with Universal, he immediately becomes something more than just a customer. He actually enters a partnership with an organization whose interests are parallel to his own.

Universal's objectives are basically the same as the petroleum refiners' . . . to provide continuing improvement of products from petroleum through constant advancement in

(*To obtain more data on advertised products see page* 1584)

refining methods and techniques. Universal endeavors to accomplish these objectives in a manner that will result in the greatest economic advantage to the petroleum refiner.

As originators and developers of many of the most successful refining processes, Universal has only a single purpose to pursue—the progress of its customers—progress based upon the intelligent understanding of processing requirements and sound interpretations that provide effective solutions to the industry's most complex problems.

The petroleum refiner's interests are our interests—his success, our success. We like to think about him as our partner—not just a customer. Unusual as it sounds—Prelude To A Partnership—does have a significant meaning in our business.

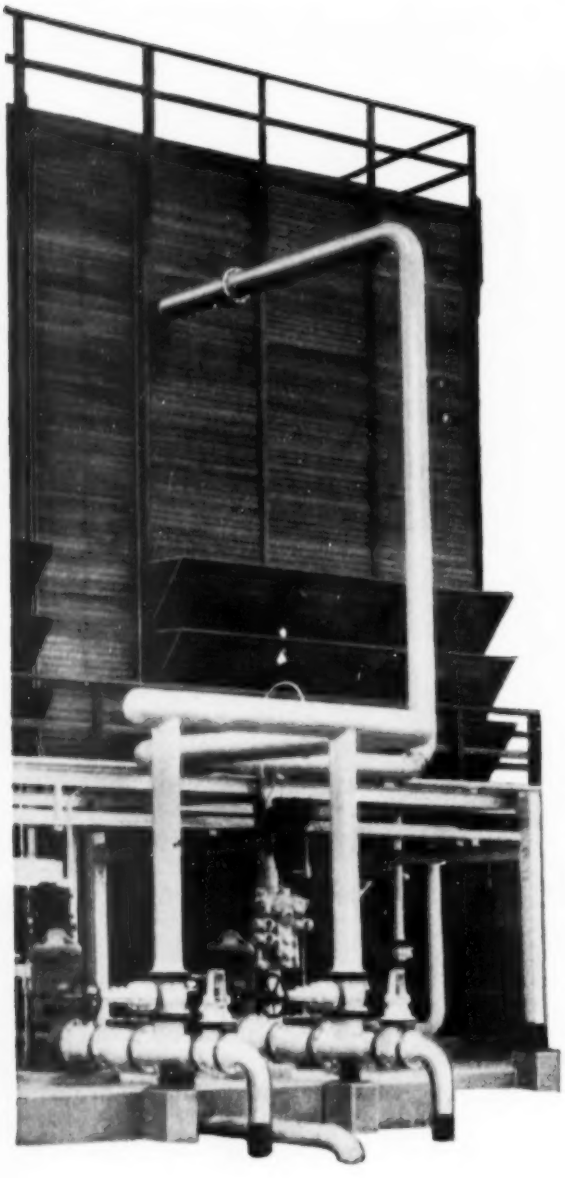
UNIVERSAL OIL PRODUCTS COMPANY

30 ALGONQUIN ROAD, DES PLAINES, ILL., U.S.A.

Laboratories: RIVERSIDE, ILLINOIS

Universal Service Protects Your Investment

YOU KNOW YOU'RE RIGHT!



Men in the petro-chemical industry who specify Pritchard cooling towers have the satisfaction of knowing they have made the right decision.

How do they know? First, Pritchard experts consult with them on exactly what is needed for the specific cooling job. Then, experienced Pritchard engineers help them select the right tower for that job . . . the unit with the proper capacity and design for efficient operation . . . maximum water-saving. Finally these men know they can depend on Pritchard to deliver such a tower because of Pritchard's acknowledged reputation for building reliable, rugged, quality units and the unconditional guarantee that Pritchard towers will perform as specified.

You'll know you're right, too, when you consult Pritchard—a founder member of the Cooling Tower Institute—about your cooling needs. Look in the classified section of your telephone directory for your nearest Pritchard representative or write direct to Pritchard's General Offices, Kansas City, Missouri.

You're right again when you specify a Pritchard QUINTAIR* *air-cooled heat exchanger for dependable, efficient cooling or condensing of liquids, gases or vapors. Quality construction assures long, trouble-free service . . . skillful design makes all parts that may require attention readily accessible for easy maintenance.*

**Registered Trade Name*

Industry's Partner for Progress

Cooling Towers
Specialized Heat Exchangers
Gas and Air Treating Equipment
Construction and Processing Facilities

J.F. Pritchard & Co.

ENGINEERS • CONSTRUCTORS • MANUFACTURERS

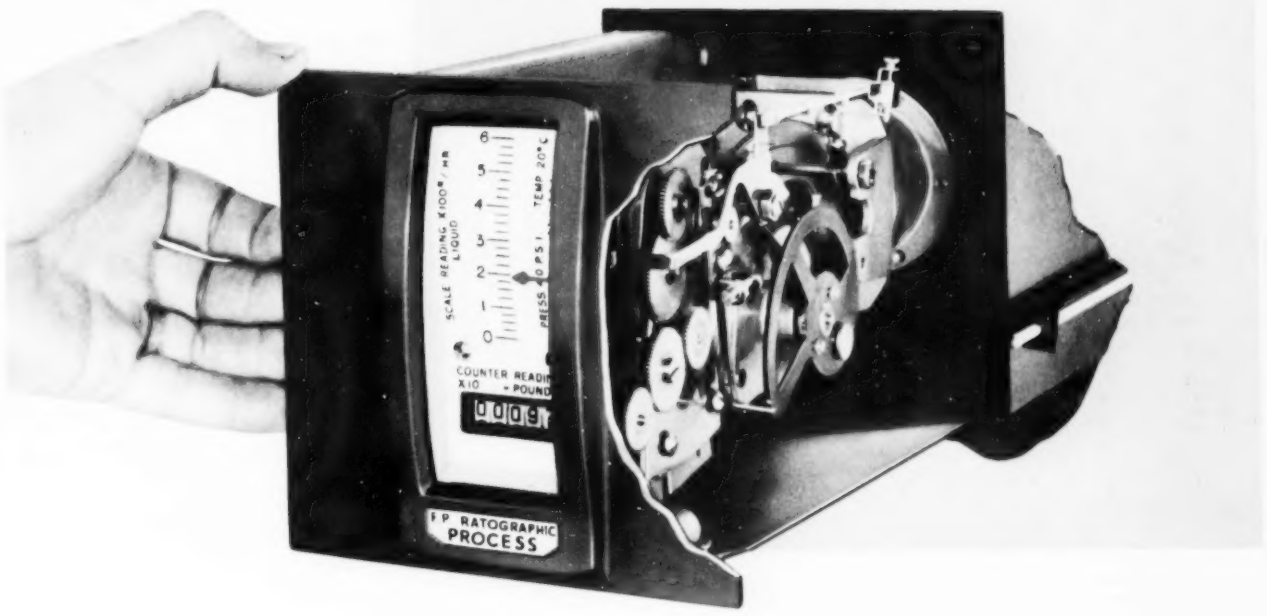
Dept. 325 210 West 10th Street, Kansas City 5, Mo.

DISTRICT OFFICES: CHICAGO • HOUSTON • NEW YORK
PITTSBURG • ST. LOUIS • TULSA

Representatives in Principal Cities from Coast to Coast

NEW

Ratographic* totalizer



complete with continuous rate indication

- continual integration at rate of 24 times per minute
- dust-proof drive mechanism immersed in oil
- heavy duty 100 rpm – 72 pole synchronous motor
- standard size pneumatic receiver and integrator
- front-of-panel accessibility and removal
- accuracy within 1% of full scale

Here, for the first time, is a *full-size*, rugged totalizer – so designed that it can be used in full size, miniature or graphic panels. A companion to the F & P Ratographic miniature indicator, it is another step in complete process instrumentation developed and perfected by the skilled engineers at Fischer & Porter Company.

The entire unit occupies only six inches square of panel space. In extended position, as shown, instrument continues to function, thus easily enables observation of mechanism. The highly accurate integrating unit gives the equivalent of continuous integration. The many other new features combined in this instrument suggest a careful comparison. Full information on request.

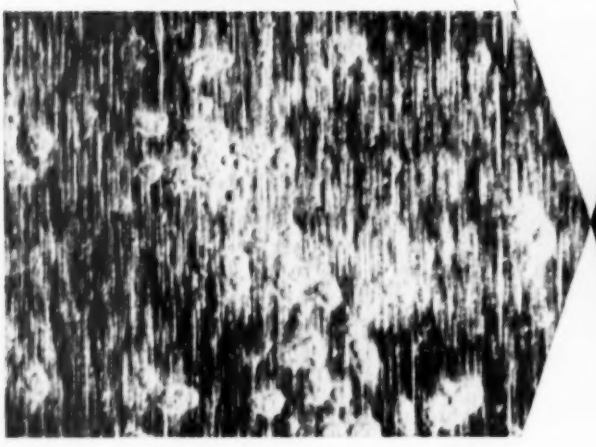
complete process instrumentation

FISCHER & PORTER CO.

*T. M., F&P Co.

1200 County Line Road, Hatboro, Penna.

Company owned sales and service branches strategically located throughout the world.



Want Complete Protection Against Water-side Scale and Corrosion?

One of the most difficult problems in corrosion control of cooling water systems is the continuance of pitting and tuberculation. But these troublesome conditions can now be eliminated quickly and effectively with the Betz Dianodic* method of corrosion inhibition.

For example, a midwestern oil refinery with a circulation rate of 40,000 gallons per minute employed "conventional" chromate treatment of the cooling water system. Inspection after 10 months operation showed satisfactory control of scale and general corrosion, but pitting and tuberculation was so serious that it was necessary to "fill-in" the end-around baffles by welding.

After a thorough engineering survey, Betz Engineers recommended the new Dianodic method of cooling water control. Here's what happened: After another 10 months operation, test specimen data showed average penetration values were reduced to 0.001 inch per year. Of greater importance, the maximum depth of the infrequent pits amounted to only 0.02 inch per year. And, the welded baffle ends were in perfect condition with the original welding marks clearly visible!

Betz Service Mark

The Dianodic method, developed by Betz Engineers, is a system of combining two anodic inhibitors in such a way as to *effectively eliminate* pitting and tuberculation and at the same time provide protection against general corrosion and scale. It is just one of the many advanced developments produced by Betz . . . the result of sound engineering and progressive research in water conditioning for over a quarter of a century. We'd be pleased to show you how you can obtain similar results in *your* plant. Write today, there's no obligation of course. W. H. & L. D. BETZ, Gillingham and Worth Streets, Philadelphia 24, Penna. In Canada: BETZ Laboratories Limited, Montreal 1.

Betz Technical Paper No. 125 gives full details of the Dianodic Method. May we send you a copy?

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

Corrosion can be controlled

COOLING HOT CHLORIDES

Because of its unusual design, this heat exchanger has two to eight times the heat-transfer of plain bare pipe or tubing. HASTELLOY alloy B gives the assembly the necessary corrosion resistance. The exchanger, which was formed from alloy B strip, pipe, and elbows, handles hot chloride-bearing chemicals.

PREPARING PROTECTION

A HASTELLOY alloy C safety valve similar to the one being lapped here was inspected recently after handling 500 "pop" reliefs of scalding acid vapors. It was found that the alloy surface still had its original polished finish.

HASTELLOY *alloys can help solve your corrosion problems, too. For further information, contact the nearest Haynes Stellite Company office listed below.*

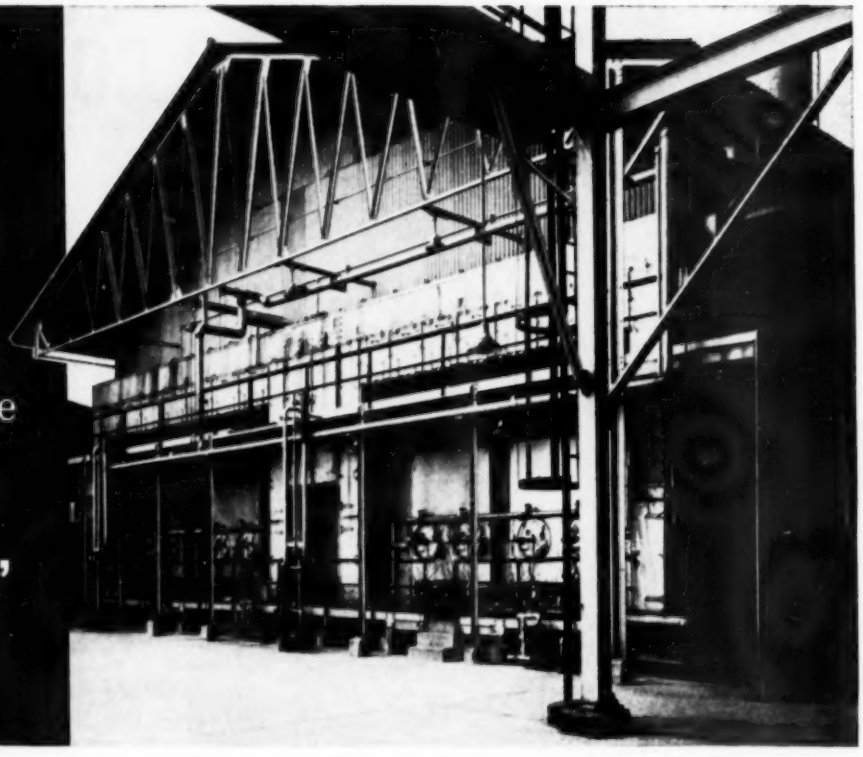
"Hastelloy" is a registered trade-mark of Union Carbide and Carbon Corporation.

HASTELLOY *alloys*
TRADE-MARK

Nickel-base, corrosion-resistant alloys available as sheet, plate, bar stock, welding rod, welded tubing and pipe; cast pipe and pipe fittings, sand and precision-investment castings.

Haynes Stellite Company
A Division of
Union Carbide and Carbon Corporation
UCC
General Offices and Works, Kokomo, Indiana
Sales Offices
Chicago — Cleveland — Detroit — Houston
Los Angeles — New York — San Francisco — Tulsa

Oil Heater Candidate For A Performance "BLUE RIBBON"



IT'S this Lummus Crude-Vacuum Oil Heater, on the job at the Paulsboro, N. J. refinery, of Socony-Vacuum Oil Company, Inc.

This unit was placed in service in November 1949. Except for a seven-day shutdown early in 1951, solely for plant considerations, ***its first run was for 3½ years.*** When the heater was opened it was found to be in good condition . . . with remarkably little maintenance necessary considering the unit's time in operation.

With a design duty of 83,000,000 Btu/hr., the heater during the last 3½ years has handled approximately 40% *more* than design rating. Refinery people say the heater could operate at even greater capacity.

Operating results like these at Paulsboro uphold Lummus' reputation as designers and fabricators of oil heater equipment for refineries, chemical, and petrochemical plants. In addition to superior performance, Lummus oil heater installations are marked by ease of operation and flexibility necessary to allow frequent switching of stocks.

Have we suggested a few important reasons why a Lummus Oil Heater will fit into your processing picture? We'll be pleased to have our specialists talk it over with you.

THE LUMMUS COMPANY

385 MADISON AVENUE, NEW YORK 17, N. Y.

HOUSTON • CHICAGO • LONDON • PARIS • CARACAS

DESIGNING ENGINEERS AND CONSTRUCTORS FOR THE PETROLEUM AND CHEMICAL INDUSTRIES

Across the Sea . . .

Shown at right in this photograph are Lummus Hot Oil Belt Heaters which satisfy by means of a circulating hot gas oil stream all heat requirements for the lube oil plant of a modern refinery at Dunkirk, France. This installation, as in the case of others similar to it, is characterized by a low initial investment since it eliminates a number of smaller heaters with their attendant engineering and erection costs.

WHEN WINTER COMES...

NATURAL GASOLINE
PROPANE
ISO-BUTANE
BUTANE
ISO-PENTANE
NORMAL PENTANE
HEXANE
HEPTANE
HEAVY NAPHTHA
STA-VOL-ENE

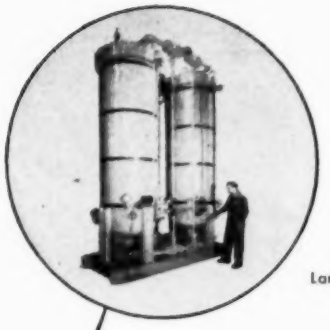
WILL YOU HAVE ENOUGH VOLATILITY?

WARREN

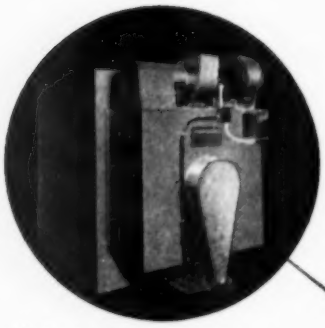
PETROLEUM CORPORATION

TULSA, OKLAHOMA CABLE ADDRESSES: Stavolene, Warren

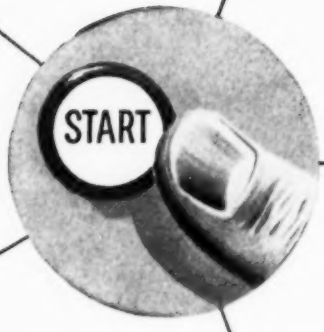
EXPORT TERMINALS: CORPUS CHRISTI, PORT ARTHUR, BAYTOWN, TEXAS CITY AND WARRENGAS, HOUSTON, TEXAS

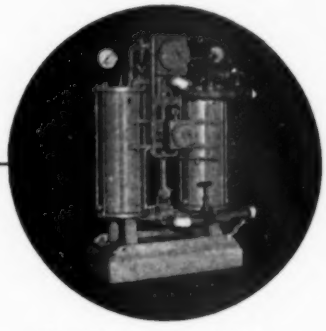


Large liquid hydrocarbon Lectrodryer.

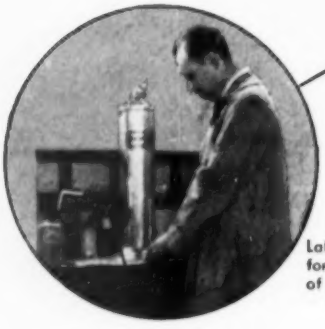


Air Conditioning Lectrodryer.

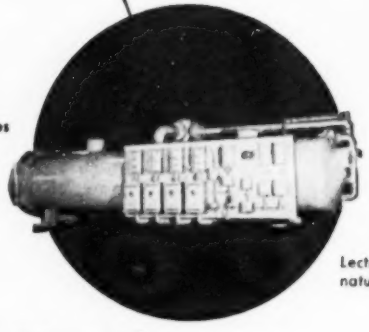




Small, dual compressed air dryer.



Laboratory Lectrodryer for drying small quantities of gases.



Lectrodryer for drying compressed natural gas.

DRYness . . .

by pressing a button!

Lectrodryers* DRY air and gases to dewpoints as low as −110°F. Moisture content of organic liquids can be reduced to 3 or 4 parts per million.

Wherever you need DRYness . . . in a laboratory jar, on stream in some tricky process, or in a warehouse . . . from atmospheric to 6000 lbs. pressure . . . there's Lectrodryer equipment to give you DRYness automatically, continuously, economically.

Petroleum, chemical, pharmaceutical, plastics and synthetic rubber industries rely on Lectrodryers to provide vital DRYness . . . speed up production . . . protect delicate chemicals.

You can predetermine the constant degree of DRYness you want. Lectrodryer engineers, calling on their 22 years of combating unwanted moisture, can provide reliable assistance.

Data Available—Write for "Because Moisture Isn't Pink," a booklet describing Lectrodryers, their function and application: The Pittsburgh Lectrodryer Corp., 332 32nd St., Pittsburgh, Pa.

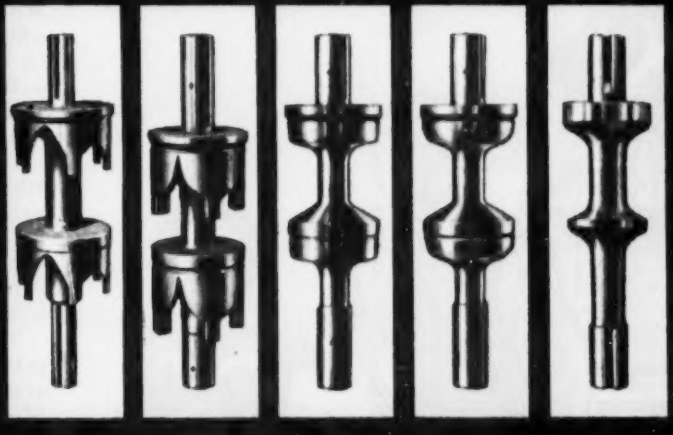
In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

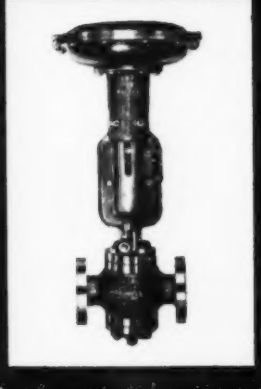
LECTRODRYER

*REGISTERED TRADEMARK U. S. PAT. OFF.

WIDE SELECTION . . .



for any valve application



Discs for the Honeywell Series 700 Valve include single and double-seated V-ported and contoured types, each with either linear or equal-percentage characteristics, plus a flat disc for on-off control . . . all ground and polished . . . all designed to retain characteristics under severe service. The Honeywell Series 700 Valve comes in a full range of styles and sizes . . . has *all* the features you look for in a fine valve. Write today for your copy of Bulletin 700-2. MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 1910 Windrim Avenue, Philadelphia 44, Pa.

MINNEAPOLIS
Honeywell
VALVE PRODUCTS

H HONEYWELL

First in Controls

The Lady was for burning

IN RURAL INDO-CHINA, a farmer once offered a traveler his prettiest daughter in exchange for a reading lamp and a drum of kerosene.

This happened, not fifty years ago, but within the last decade.

It is hard for Americans to imagine what life is like in the "have-not" nations of the world. Some communities in Honduras have never seen petroleum, nor any product thereof. In Western Africa it is not unusual to find one lamp in a tribal group of 15,000 people.

The fact that a country has no petroleum resources of its own is not always the reason for oil poverty. Many so-called "have-nots" live in land where oil could be found. What they really "have not" is the initiative to look for it!

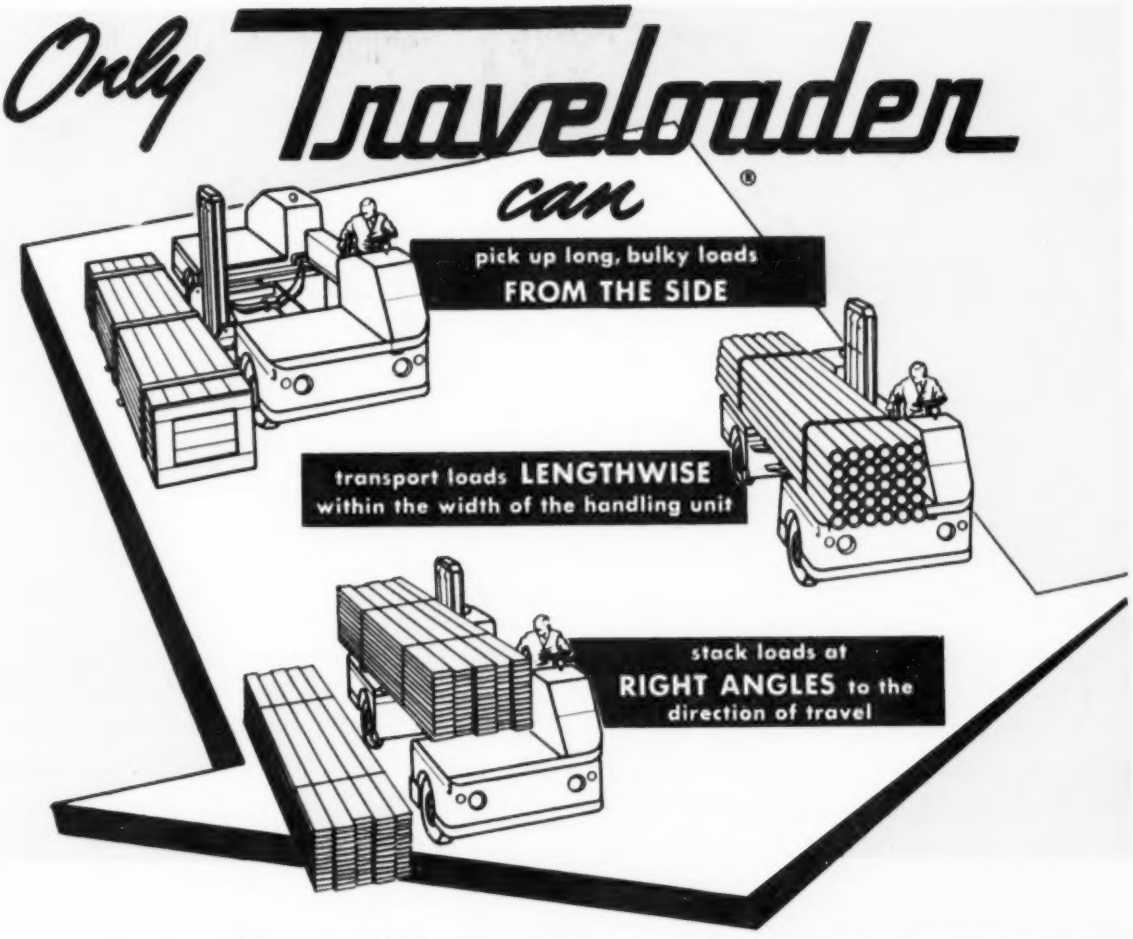
The oil companies of America have a super-abundance of that great natural resource—Initiative. It is essential to their success. They cannot afford to discourage easily, for the odds are ten to one against a wildcat becoming a producer.

In spite of these odds, Cities Service has discovered some of America's historic oil fields. In the last five years, its geologists have added millions of barrels of much-needed oil to our national reserves. Because of these men, and others like them throughout the industry, we can be sure our country will never be one of the petroleum have-nots of the world.

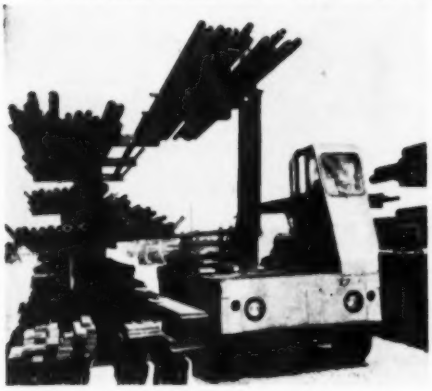
CITIES SERVICE

Quality Petroleum Products

Only Traveloader can®


pick up long, bulky loads
FROM THE SIDE
transport loads LENGTHWISE
within the width of the handling unit
stack loads at
RIGHT ANGLES to the
direction of travel

...and do all 3 with ONE MACHINE and ONE OPERATOR!



An ideal combination for efficient yard storage of pipe, bar stock, long steel shapes, etc.—Traveloader and "Christmas tree" racks.

Here is an entirely new approach to mechanized handling of big, bulky, awkward or long loads. By combining side-loading fork lift and pneumatic tired carrier in a single machine, TRAVELOADER answers many problems that defy solution with any other equipment.

TRAVELOADER LOADS FROM THE SIDE. You simply drive beside the load, pick it up and move on in the same straight line. No time wasted in maneuvering or backing up. Operates easily in 10 ft. aisles with loads of any length.

TRAVELOADER CARRIES LOADS LENGTHWISE. Any length and any width up to 5 ft. rides securely on the truck deck—within the width of the unit. Narrow roadways or doors and low ceilings present no problem. Weight is distributed equally over four wheels. Travels safely at speeds up to 30 MPH.

TRAVELOADER UNLOADS OR STACKS AT RIGHT ANGLES TO TRAVEL DIRECTION. Safely tiers to heights of 12 ft. alongside narrow aisles. Increases capacity of storage areas and eliminates need for additional equipment or personnel. One man does it all!

write for descriptive bulletin containing action photographs, construction details and specifications.

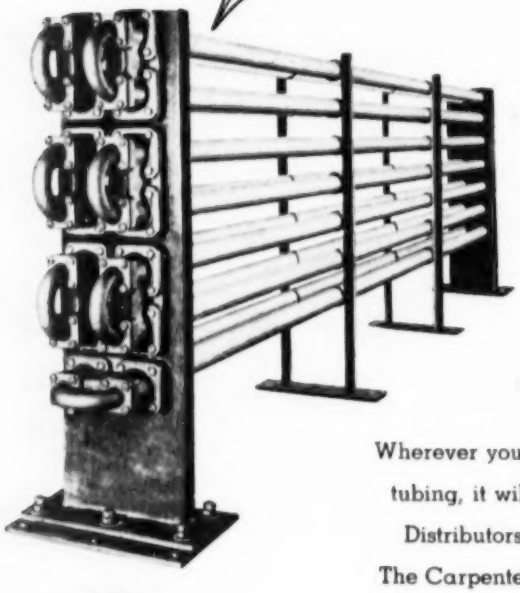
THE BAKER-RAULANG COMPANY
1248 WEST 80th STREET • CLEVELAND 2, OHIO

The Baker-Lull Corporation, Subsidiary, Minneapolis, Minnesota
Material Handling and Construction Equipment

Baker
industrial trucks

(To obtain more data on advertised products see page 1584)

Carpenter Stainless Tubing KEEPS PROCESSES GOING ON SCHEDULE



Modern heat transfer equipment has to stay on the job. You can't afford to interrupt a process for hours or days to replace tubes.

That's why the manufacturer of these units selected Carpenter Stainless Tubing, Type 316. In addition to providing good corrosion resistance, Carpenter tube quality and uniformity help to make the 20th unit as good as the first.

Wherever your processing equipment involves corrosion-resistant tubing, it will pay to put Carpenter experience to work for you. Distributors are located in principal cities from coast to coast.

The Carpenter Steel Company, Alloy Tube Division, Union, N. J.

Export Dept.: The Carpenter Steel Co., Port Washington, N. Y. "CARSTEELCO"

Send for this USEFUL SLIDE CHART

Physical properties, sizes and gauges, cross-sectional areas, velocity constants, pressures, weights and other technical data on Carpenter Stainless Tubing for heat exchanger applications are condensed into this handy chart. It's yours for the asking, on your company letterhead.

Carpenter

STAINLESS TUBING & PIPE

Analysis · Tolerance · Finish

- guaranteed on every shipment

BIG VALVE, LITTLE EFFORT...
BECAUSE IT'S *LUBRICATED*

A big valve doesn't necessarily mean a hard valve to operate. If it's a Nordstrom, even the biggest valve, in the highest line pressures, can be operated easily by one man, without extension rods or sledges. There are two reasons—

First . . . the Nordstrom pattern of internal lubrication—a practical application of Pascal's law—which jacks the plug hydraulically to turn with low torque.

Second . . . the Nordstrom design, in which a plug revolves *within* the line of flow on a film of lubricant, instead of a disk which must be forcibly wedged into the seat *against* the line of flow.

And, of course, all Nordstrom Valves are lubricant sealed.

Rockwell Manufacturing Company, Pittsburgh 8, Pa.

ROCKWELL Built
Nordstrom Valves
Lubricant-Sealed for Positive Shut-Off

Another ROCKWELL Product

Your automobile will operate without lubrication.
So will most valves, including

NORDSTROM VALVES

But you lubricate your car to reduce wear—to make it easy for metal parts to move against each other without galling—to add to your car's life and cut down on expensive repairs and replacement.

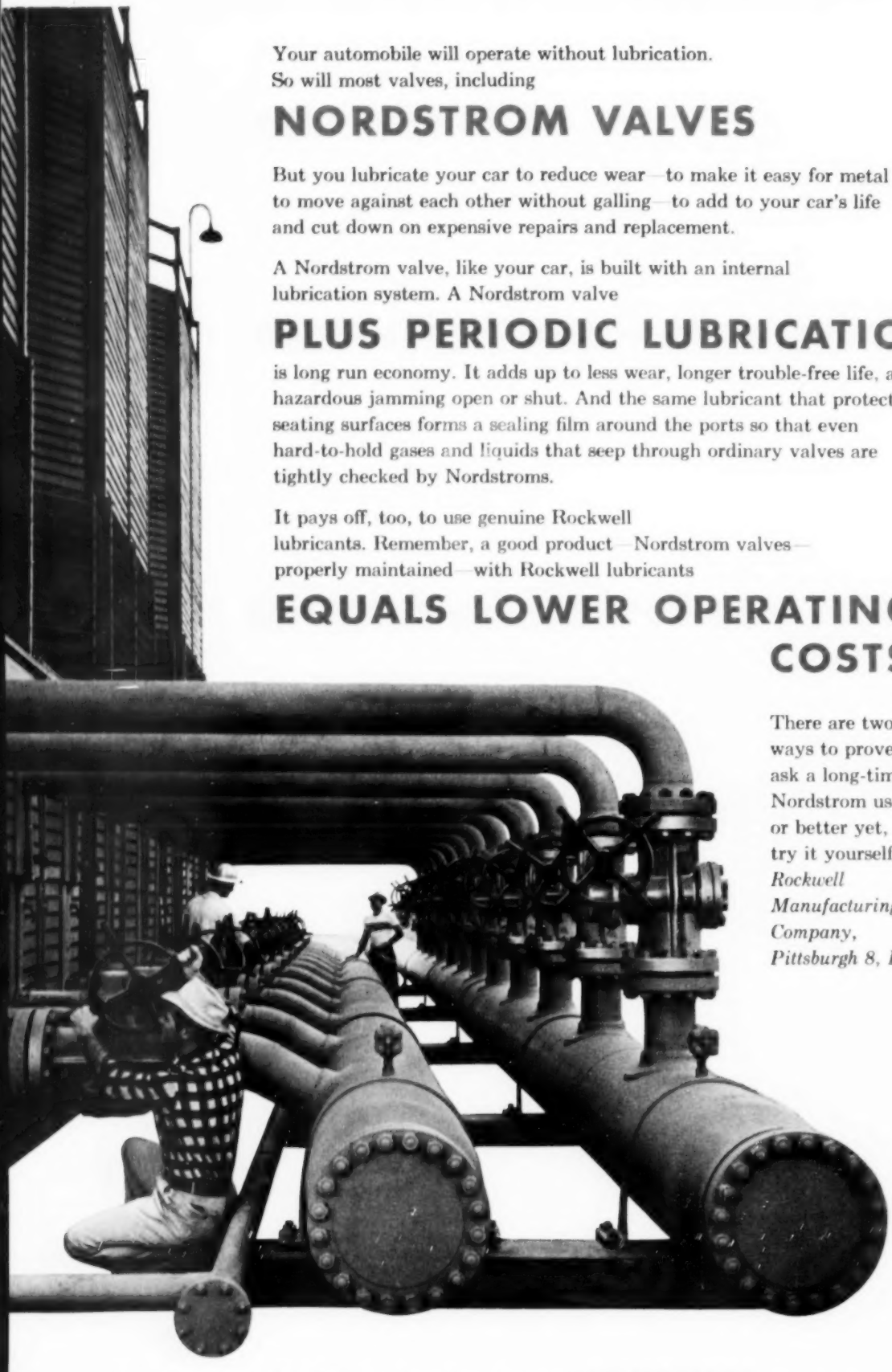
A Nordstrom valve, like your car, is built with an internal lubrication system. A Nordstrom valve

PLUS PERIODIC LUBRICATION

is long run economy. It adds up to less wear, longer trouble-free life, and no hazardous jamming open or shut. And the same lubricant that protects seating surfaces forms a sealing film around the ports so that even hard-to-hold gases and liquids that seep through ordinary valves are tightly checked by Nordstroms.

It pays off, too, to use genuine Rockwell lubricants. Remember, a good product—Nordstrom valves—properly maintained—with Rockwell lubricants

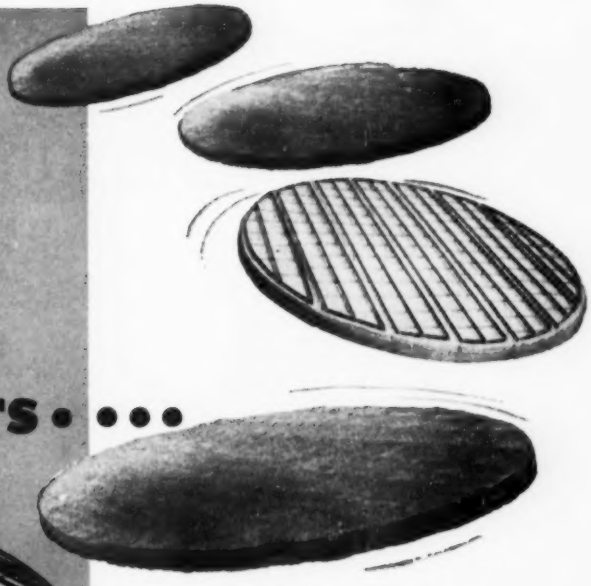
EQUALS LOWER OPERATING COSTS

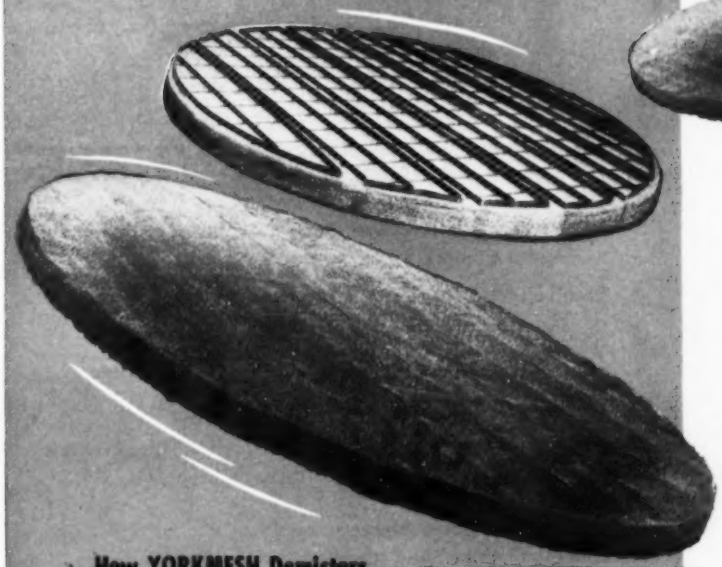


There are two ways to prove this: ask a long-time Nordstrom user, or better yet, try it yourself.
Rockwell Manufacturing Company, Pittsburgh 8, Pa.

Nordstrom Valves Another Quality **ROCKWELL** Product

Higher Gasoline Yields and Increased Cracking Capacity with YORKMESH DEMISTERS in Vacuum Towers • • •





YORKMESH Demisters are answering Petroleum Engineers' demands the world over for simple means of improving the performance and increasing the throughput capacities of catalytic cracking units.

Yorkmesh Demisters in Vacuum Towers remove substantially all liquid entrainment even at increased vapor velocities—the gas oil then produced has lower carbon content and considerably reduced metals content—the reduced metals content accounts for continued high catalyst activity. The net result is more gasoline of higher octane rating.

Yorkmesh Demisters are used equally successfully to improve the performance of gas absorbers, scrubbers, separators, evaporators, knock-out drums, etc.

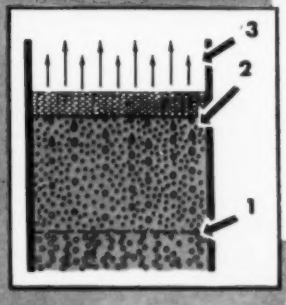
Easily installed in existing or new equipment.—Materials: Types 430, 304, 316 stainless, monel, carbon steel, etc.—Prompt shipment.

How YORKMESH Demisters work inside Vacuum Towers

1 *Vapor disengaging from liquid creates fine liquid droplets which are carried on entrainment by the vapor stream.*

2 *The liquid droplets impinge on the fine wire surfaces of YORKMESH, and are coalesced into large drops which run down and fall off the YORKMESH.*

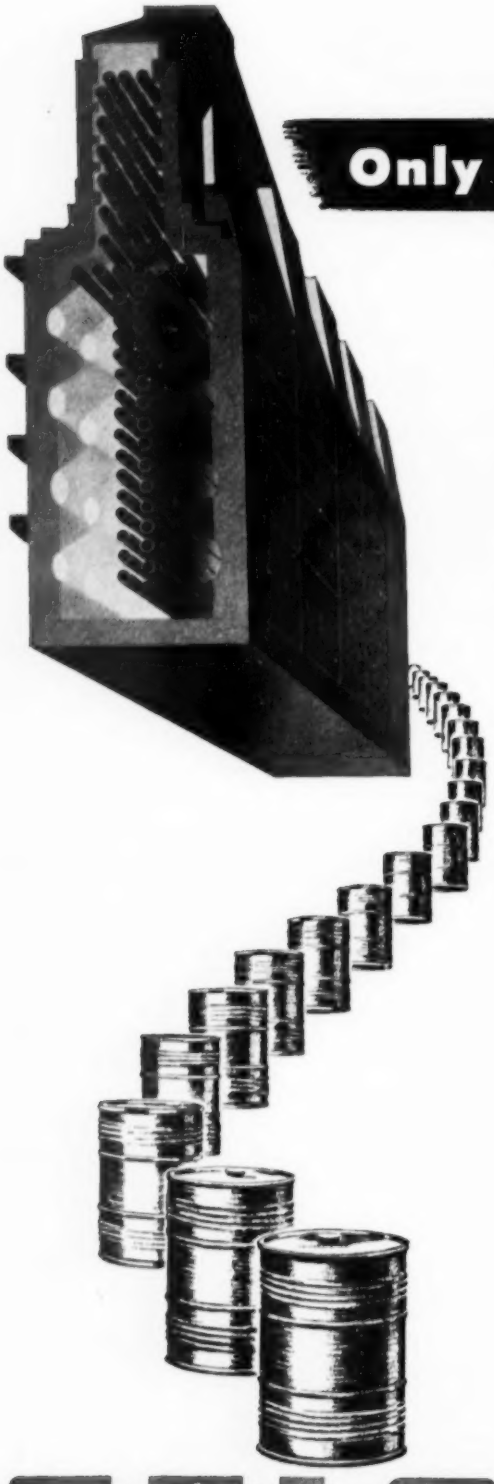
3 *The vapor is now dry. It has been entirely freed from entrained liquid. Thus a clean gas-oil goes to the catalytic cracker.*



Write for new Catalog 13 for complete information and engineering data on YORKMESH Demisters.

OTTO H. YORK CO., INC.

67 Glenwood Place, East Orange, N. J.



Only the Heater used in

*ifp**

PROVIDES ALL THESE

1. Direct, controlled radiant heat along and around the horizontal heating tubes
2. High, uniform rates of heat transfer
3. Heat input to match any desired heating curve
4. Low residence time at temperature, where desirable
5. Complete combustion, with little or no excess air
6. Positive heat rate control at either high or low temperature operation

Petroleum and petrochemical heaters, featured by performance as exemplified above, form a part of the over-all Selas activities in the *Improved Fluid Processing* of air, gas and liquids. Removal of water, oil and vapors from instrument or process air and the phase separation of liquids are functions of other Selas refinery apparatus.

IFP* is not a piece of equipment . . . nor simply a method. It is a combination of modern techniques and equipment, fitted to specific needs by engineers with refinery operation backgrounds.

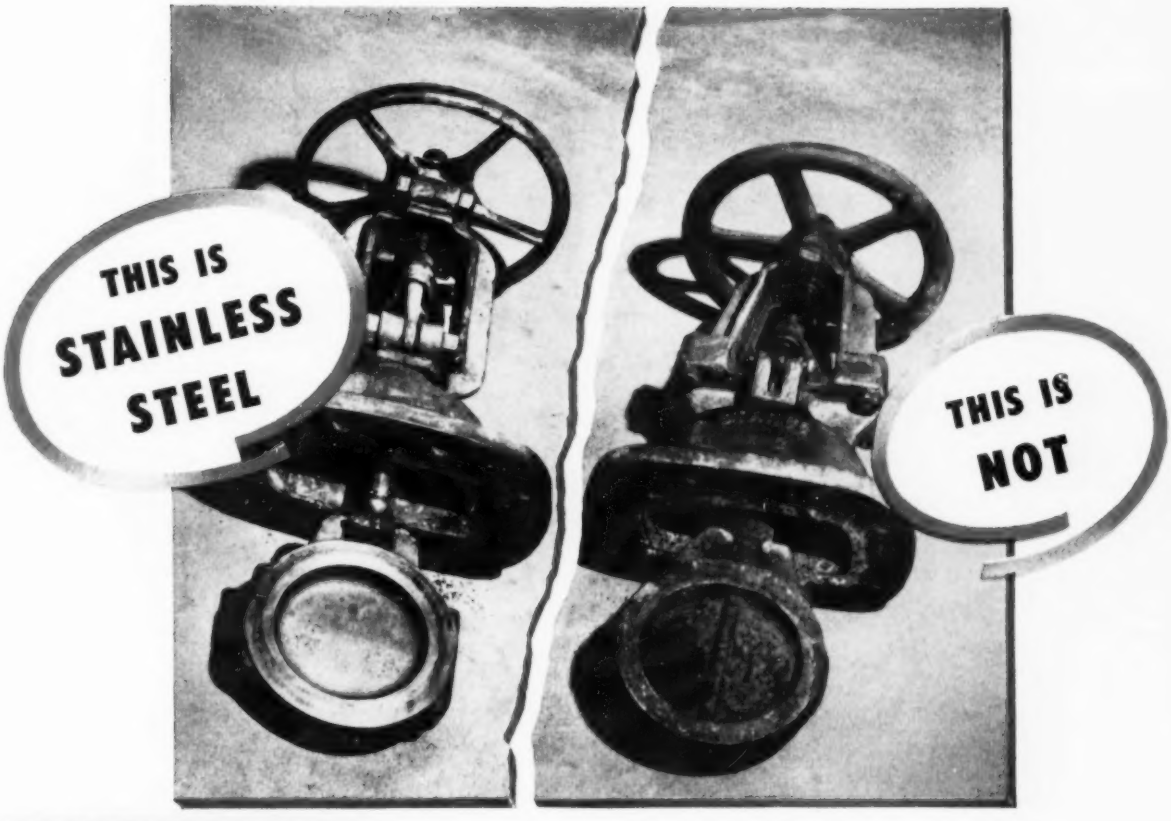
A letter will bring you full details.

**Improved Fluid Processing*

SELAS

CORPORATION OF AMERICA
PHILADELPHIA 34, PENNSYLVANIA

Heat Processing Engineers for Industry • Development • Design • Manufacture



ANOTHER GROUP of Stainless Steel valves used in the operation of this Gulf Coast Refinery.

—yet the Stainless valve is twice as old!

HERE'S photographic evidence of the way Stainless Steel's superior corrosion resistance keeps it in service under severe conditions far longer than other materials.

Both of these end gate valves were in service in one of the pipe stills at a Gulf Coast Refinery. The valve at the left, trimmed with Stainless Steel, is still in excellent condition after two years of service in light Crude Naphtha containing sulfur compounds. But the other valve, made of less durable materials, failed after a year of the same kind of service.

Stainless Steel's ability to stand up under severe service pays off in fewer costly shutdowns, less maintenance and longer equipment life. In many applications, it is far and away the most economical material you can use.

For finest performance, make sure the Stainless you use is perfected, service-tested U·S·S Stainless Steel.

UNITED STATES STEEL CORPORATION, PITTSBURGH · AMERICAN STEEL & WIRE DIVISION, CLEVELAND
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO · NATIONAL TUBE DIVISION, PITTSBURGH
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. · UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

U·S·S STAINLESS STEEL

USS

SHEETS · STRIP · PLATES · BARS · BILLETS
PIPE · TUBES · WIRE · SPECIAL SECTIONS

3-875

UNITED STATES STEEL

Graphic control... *for leading industries*

The well-established trend to centralized graphic instrumentation has brought with it many specific advantages to the operation of complex, modern processing units. And to realize most fully the potential advantages of improved efficiency, simpler supervision and better coordination, many leading companies have turned to Honeywell graphic control.

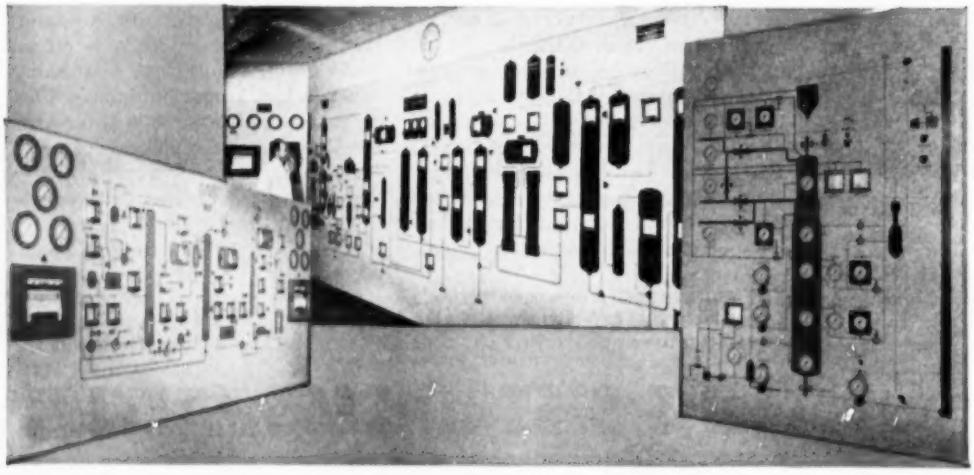
Among the engineering, construction and producing organizations which use Honeywell panels are some of the best-known names in their fields. The ever growing list includes:

C. F. Braun
Catalytic Construction Co.
The Fluor Corporation Ltd.
Foster Wheeler Corp.
Gulf Oil Corporation
Imperial Oil of Canada
M. W. Kellogg
The Lummus Co.
Pan-Am, Southern
Phillips Petroleum Co.
The Refinery Engineering Co.
Shell Oil Co.
Sinclair Refining Co.
Socony-Vacuum Oil Co.
Standard Oil Co. of California
Standard Oil Co. of Indiana
Standard Oil Co. of New Jersey
The Texas Company
Tide Water Associated Oil Company
Union Oil Co. of California

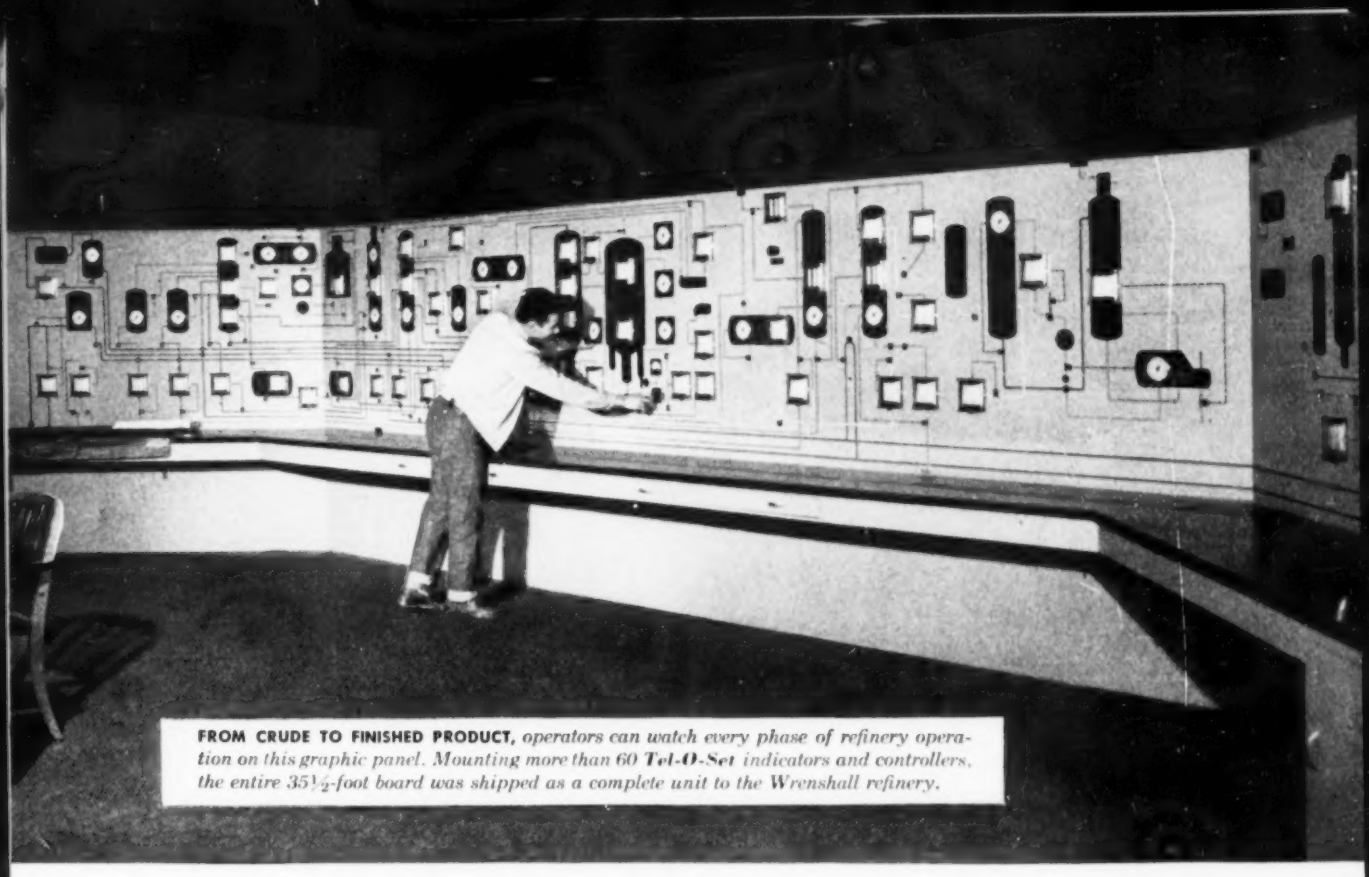
Reasons for acceptance

Behind this industry-wide acceptance stand several definite reasons. First is system engineering . . . by graphic panel specialists who translate process requirements into an integrated, harmonious design. Second is instrumentation . . . including a full line of *Tel-O-Set* miniature indicators, recorders and controllers, and *ElectroniK* instruments for supplementary recording, which enable Honeywell to satisfy the requirements of every phase of process control. And third is workmanship . . . skilled assembly either in a manufacturing department devoted exclusively to this work, or, if desired, at the job site by our own experienced branch installation crews—an organization built up over 15 years for the installation of industrial and commercial control systems.

Graphic control *centralized*



FUNCTIONAL DESIGN *for maximum efficiency is the keynote of Honeywell graphic instrumentation. These typical panels show a few of the varied types which have been built for varied process applications.*



FROM CRUDE TO FINISHED PRODUCT, *operators can watch every phase of refinery operation on this graphic panel. Mounting more than 60* ***Tel-O-Set*** *indicators and controllers, the entire 35½-foot board was shipped as a complete unit to the Wrenshall refinery.*

for complete refinery *on a single Honeywell panel*

THE MOST up-to-date concepts of petroleum processing were embodied in International Refineries' new plant at Wrenshall, Minnesota. Designed and built by the Lummus Company, this refinery produces straight run, cracked and polymer gasolines, diesel and other fuel oils, all of which are distributed by Western Oil & Fuel Co.

An outstanding feature of this new refinery is its continuous flow operation . . . no intermediate storage tanks are needed between processing stages. This "straight through" design naturally calls for precise, closely integrated control of related processes. To meet these exacting control requirements, refinery and design officials selected Honeywell graphic control.

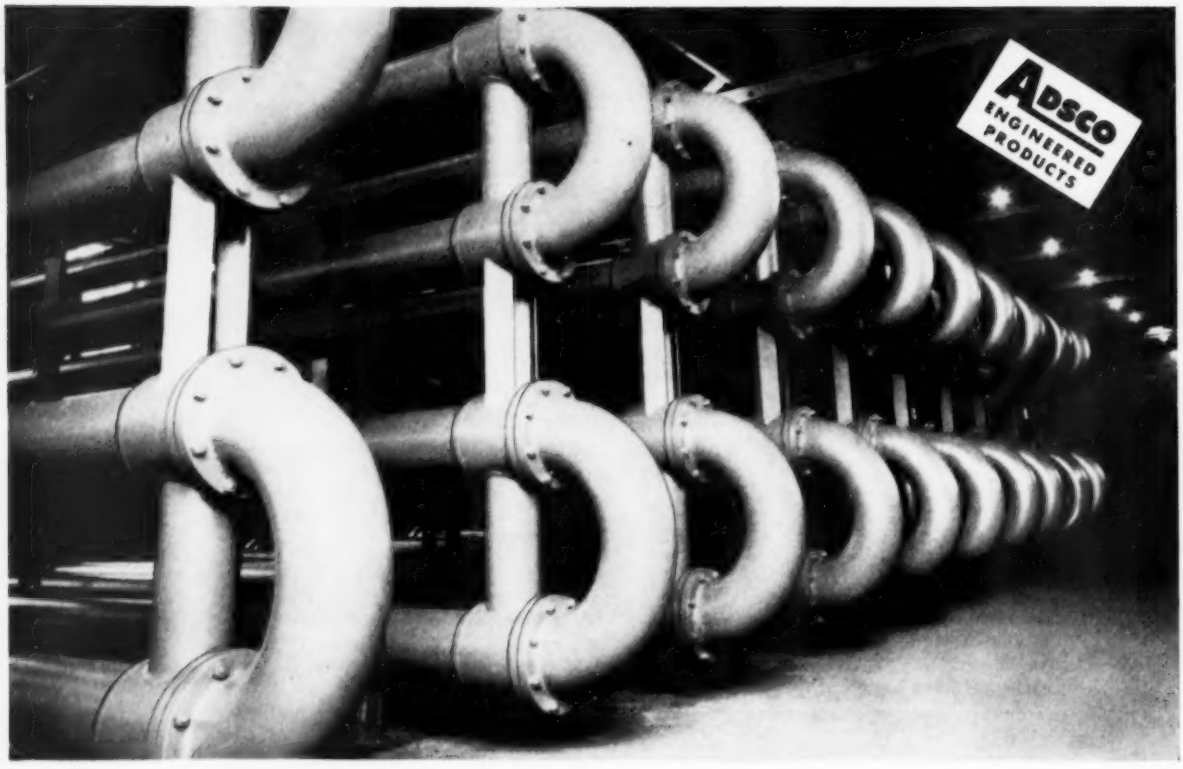
The big graphic panel shown above combines all the instrumentation for eight different refining processes. Operators can follow the entire functioning of the plant from crude to finished products, from this single control center. Worked out in detail by Honeywell design specialists, this panel does the job that would ordinarily require four or more separate panels. Not only were substantial savings effected in space, but the panel affords complete centralization of plant control . . . flexibility to meet seasonal variations in product demand . . . and maximum efficiency of process supervision, both for operators and for management personnel.

Your nearby Honeywell sales engineer will welcome the opportunity to discuss your graphic control requirements. Call him today . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4582 Wayne Ave., Philadelphia 44, Penna.

● **REFERENCE DATA:** Write for Bulletin 85-20, "Centralized Instrumentation . . . unlimited."

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls



NEW CELLULOSE PLANT SALVAGES MAXIMUM HEAT WITH THESE 40 ADSCO HEAT EXCHANGERS STACKED IN SERIES

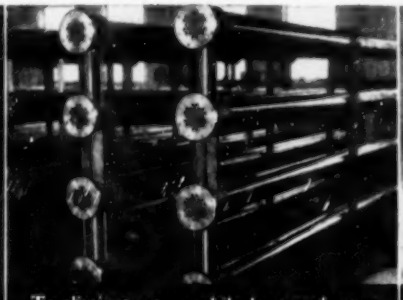
High efficiency in the causticizing department of a new cellulose plant erected by one of the largest concerns in the country is achieved by these ADSCO Heat Exchangers. In the process, one liquid must be cooled, the other heated. The ADSCO exchanger thus accomplishes two jobs in one. To achieve the small terminal temperature differences desired, counterflow design, with the exchangers in series, was necessary. Straight-tube, fixed-tube-sheet construction was selected as the most economical design.

Liquid in the tubes passes from one tube bundle to another through the 180° elbows at the ends; liquid in the shells passes from shell to shell through the short vertical connecting pipes. Hot corrosive liquor holds no terror for these exchangers because tubes and tube sheets are of stainless steel . . . These 40 exchangers are evidence of the contribution which ADSCO can make to the sound engineering required in chemical and petroleum processing plants. . . . Your ADSCO representative invites inquiries.

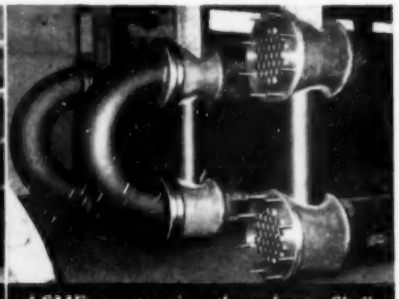
AMERICAN DISTRICT STEAM COMPANY, INC. NORTH TONAWANDA, NEW YORK

ADSCO ENGINEERED PRODUCTS FOR THE CHEMICAL, GAS AND OIL INDUSTRIES

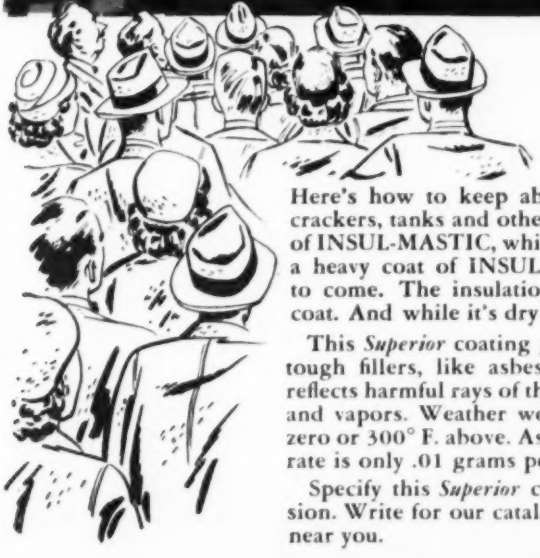
ADSCO is widely known for the high quality of its welding. Here, a workman is welding a support to shell of exchanger.



To eliminate stress while heat exchanger is in operation, tubes are roller expanded into tube sheets while unit is steam heated.



ASME construction throughout. Shell design pressure, 200 lbs.; test, 400 lbs. Tube design pressure, 150 lbs.; test, 300 lbs.



It's going on over thermal insulation as a vapor and weather barrier

Here's how to keep absorbent insulation dry on fractionation towers, "cat" crackers, tanks and other vessels. First press membraning cloth into a light coat of INSUL-MASTIC, which has been sprayed over the insulation. Then spray with a heavy coat of INSUL-MASTIC. That ends the insulation worries for years to come. The insulation stays dry and efficient beneath its INSUL-MASTIC coat. And while it's dry your metal equipment can't rust beneath its insulation.

This *Superior* coating gives lasting protection because of its flexibility and its tough fillers, like asbestos, which absorbs physical abuse, and mica, which reflects harmful rays of the sun. Its large Gilsonite content resists industrial fumes and vapors. Weather won't harm INSUL-MASTIC. It will stand 40° F. below zero or 300° F. above. As for being watertight . . . its moisture vapor transmission rate is only .01 grams per 100 square inches per 24 hours per ⅛ inch.

Specify this *Superior* coating for your thermal insulation or to prevent corrosion. Write for our catalog and the name of the INSUL-MASTIC Representative near you.

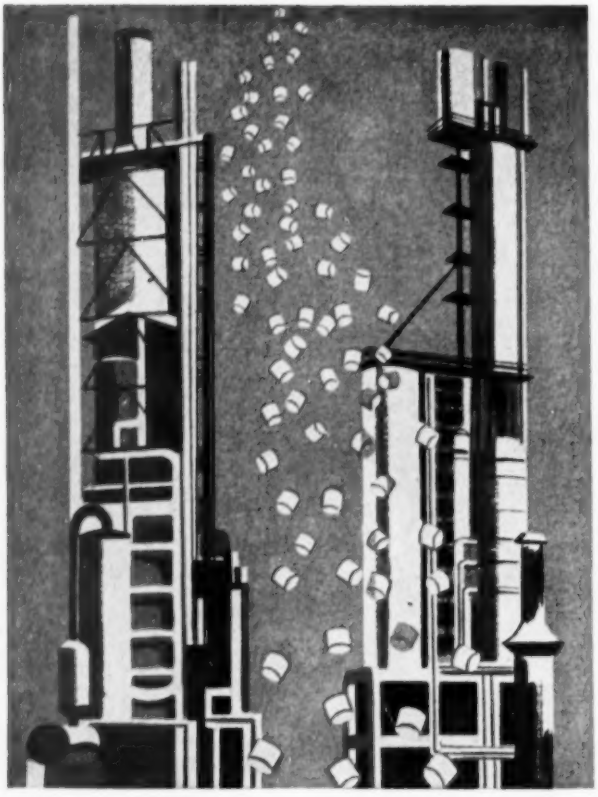
Think First of the Coatings that Last!

Where less insulation is needed use INSUL-MASTIC TYPE "D". One coat over metal insulates and also prevents corrosion.

Insul-Mastic

CORPORATION OF AMERICA
Oliver Building • Pittsburgh 22, Pa.

Representatives in Principal Cities



Filtrol SR Pelleted Cracking Catalyst

FOR HOUDRIFLOW AND AIR-LIFT TCC UNITS. FILTROL SR CATALYST IS NOW BEING USED SUCCESSFULLY IN COMMERCIAL OPERATION. SR CATALYST YIELDS HIGH OCTANE CATALYTIC GASOLINE AND CAN BE USED PROFITABLY IN CRACKING A FULL RANGE OF GAS OILS, INCLUDING HIGH SULFUR BEARING STOCKS. SHOWN BELOW ARE THE CHARACTERISTICS OF SR CATALYST AS COMPARED TO REGULAR FILTROL TCC PELLETED CATALYST USED SO SUCCESSFULLY SINCE 1943:

GRADE	FILTROL TCC (23)	FILTROL SR (63)
ACTIVITY BY CAT A	40	36
CPF	1.0	1.0
PELLET DIAMETER	0.19"	0.19"
MESH 3-6 MESH	99%	98.5%
HARDNESS	70	93 MIN.

TYPICAL YIELDS OF SR AS COMPARED TO REGULAR FILTROL TCC ARE:

GRADE	FILTROL TCC (23)	FILTROL SR (63)
CYCLE OIL, VOL. %	48	48
DEBUT. GASO., VOL. %	42	40.5
DRY GAS, WT. %	5.0	5.8
TOTAL C_4, VOL. %	12	13.5
COKE, WT. %	4.8	3.9
OCT. NO. F-1 CLR.	90	92.5

OTHER
REASONS FOR USING
FILTROL CATALYSTS

1. Higher Octane Barrels
2. High Butylene Yield
3. Low Cost
4. Varied Plant Facilities
5. Faster Regeneration Rate
6. Low Attrition Rate
7. Technical Service
8. Uniformity
9. Lowered Excess Butane

Filtrol*

*T. M. REG. U. S. PAT. OFF.

FILTROL CORPORATION

OFFICES: 727 WEST SEVENTH STREET, LOS ANGELES 17, CALIFORNIA
PLANTS: VERNON, CALIF.; SALT LAKE CITY, UTAH; JACKSON, MISS.

CATALYSTS AND ADSORBENTS

Here's how FLUOR PRODUCTS serve gas compressor stations

1 FLUOR COUNTERFLO COOLING TOWER

is the "true economy" tower: efficient design, economical operation and maintenance, and low initial cost. Completely prefabricated.

2 FLUOR AIR COOLED FIN-FAN

cools liquids, vapors and gases at pressures up to 5,000 psi in sizes to meet any requirement, with low first cost and low operating cost.

3 FLUOR MUFFLERS

are dependable, inexpensive mufflers for 2 and 4 cycle engines, through a broad range of makes, models and horsepower ratings. Maximum noise attenuation with minimum engine back pressure.

4 FLUOR PULSATION DAMPENERS

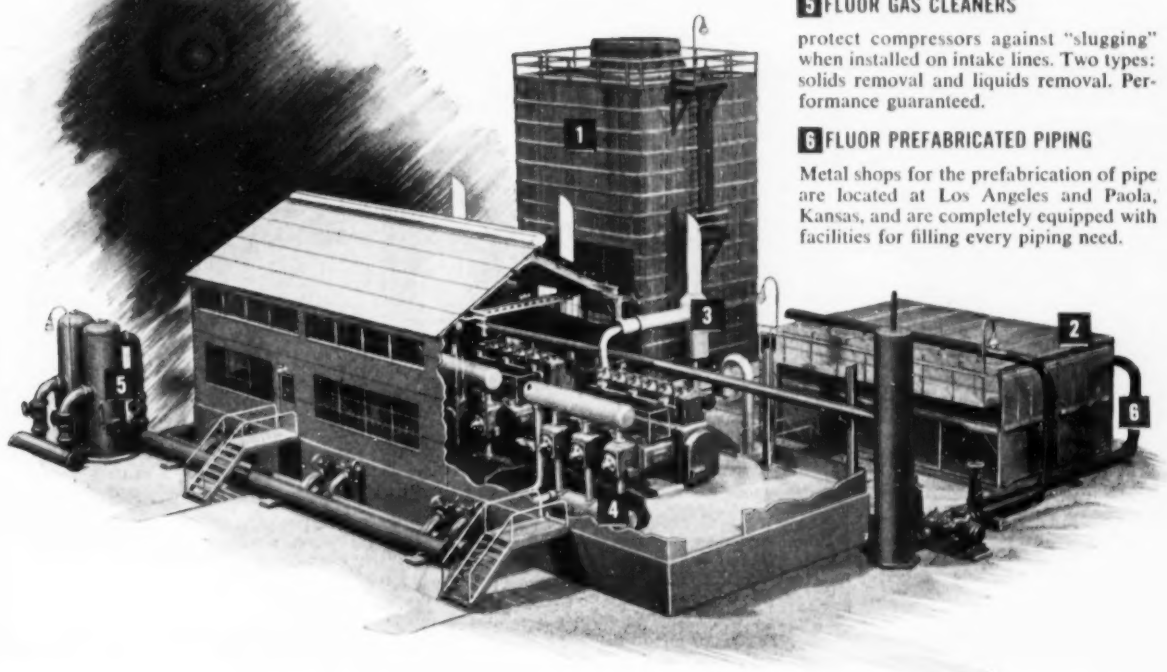
eliminate pulsations in pipe, improve the accuracy of metering and decrease plant vibration. A Fluor Pulsation Dampening System can be installed at a cost comparable to original piping.

5 FLUOR GAS CLEANERS

protect compressors against "slugging" when installed on intake lines. Two types: solids removal and liquids removal. Performance guaranteed.

6 FLUOR PREFABRICATED PIPING

Metal shops for the prefabrication of pipe are located at Los Angeles and Paola, Kansas, and are completely equipped with facilities for filling every piping need.



This miniature compressor station which was on display at the Oil Show in Tulsa, Oklahoma, shows exactly how Fluor products and services provide a compressor station with greater efficiency. The Fluor Counterflo Coilshed Cooling Tower is cooling compressed natural gas. Engine jacket water and lube oil cooling is being performed by a Fluor Fin-Fan Air Cooled Heat Exchanger. Fluor Mufflers abate engine noise while Pulsation Dampeners convert a pulsating gas flow into a steady, even stream. Fluor Gas Cleaners on the intake side of a plant remove both solids and liquids from gas, and all units are connected with Fluor Prefabricated Piping. Fluor not only manufactures these specialized products, but also contracts for the design, construction and expansion of complete compressor stations.

Wherever oil is refined, natural gas is compressed or treated, chemicals and petrochemicals are processed, power is generated, and where large-scale manufacturing is in operation—Fluor products can perform a job for you. For information on Fluor products and engineering services contact your Fluor representative or write for Catalog RC-8523.

BE SURE WITH

FLUOR

THE FLUOR CORPORATION, LTD.
LOS ANGELES 22, CALIFORNIA

FOREIGN FACTS-FLUOR PARIS
FLUOR OF CANADA-TORONTO
FLUOR INTERNATIONAL-BEIRUT
HEAD WRIGHTSON-LONDON

ENGINEERS
CONSTRUCTORS
MANUFACTURERS

NEW YORK
CHICAGO
PHILADELPHIA
BOSTON
PITTSBURGH
SAN FRANCISCO
HOUSTON
BIRMINGHAM
TULSA

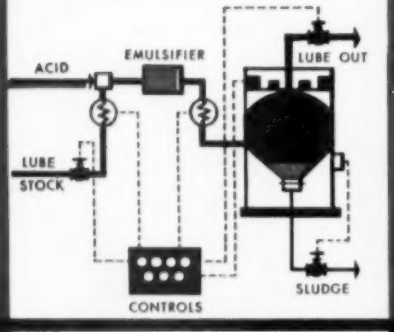
(To obtain more data on advertised products see page 1584)

IF YOU ACID TREAT LUBE OILS OR SIMILAR STOCKS

PETRECO *Electric* LUBE OIL TREATING

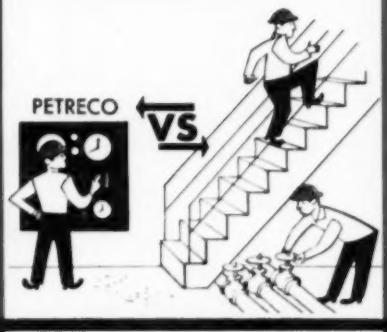
ASSURES BETTER, MORE ECONOMICAL ACID TREATING BECAUSE OF THESE OPERATING ADVANTAGES

CONTINUOUS OPERATION



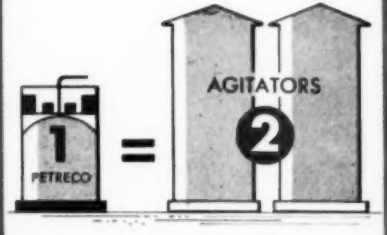
Petreco electric lube oil treating operates continuously, eliminating the many manual operations of old-fashioned batch treating.

AUTOMATIC CONTROL



Automatic controls take time-consuming valve-twirling and stair-climbing out of acid treating. Precision control replaces guesswork.

HIGH EFFICIENCY



The powerful coalescing action of the Petreco electric field insures a fast, clean-break separation of the oil-acid mixture.

PL 53-2

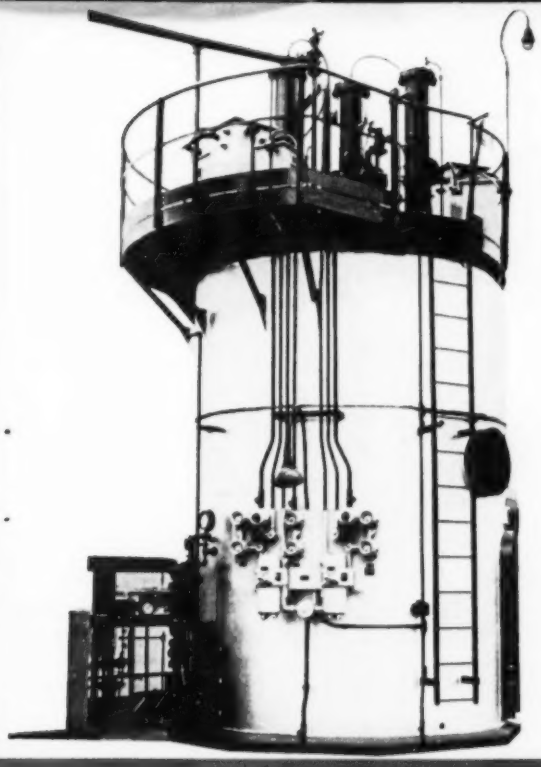
for complete information, call or write

PETROLITE CORPORATION

PETRECO DIVISION

3202 So. Wayside Drive, Houston 1, Texas

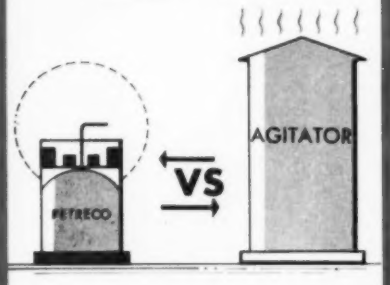
1390 E. Burnett Street, Long Beach 6, California



PETRECO ELECTRIC LUBE OIL TREATING applies modern refining practice to the acid treating of lube oils and similar stocks. The stock to be treated is thoroughly mixed with the pre-determined proportion of acid; the resulting mixture is then passed into the Petreco treater. The powerful action of the electric field precipitates the sludge, which is automatically and continuously drawn off. The treated oil passes overhead to the neutralization step.

Petreco treating takes the acid treating of lube stocks out of the manual operation, batch treatment category and puts it in the same class as other modern processes. It provides better, more uniform treating conditions, requires minimum operating attention and insures a rapid pay out.

CLOSED SYSTEM

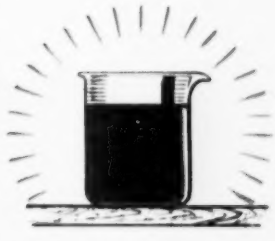


In the Petreco process, treating is effected in a closed vessel, under pressure. There is no chance for acid spray or fumes to pollute the air.

LOW ACID REQUIREMENTS

The high separating efficiency of the Petreco treater permits the acid and oil to be intimately mixed. Less acid does more work.

IMPROVED PRODUCT



The very brief oil-sludge contact time prevents the continuing reaction of constituents dissolved by the acid, insuring excellent treated product quality.

PETRECO

ELECTRIC PETROLEUM PROCESSING

CRUDE OILS	**Removal of salts, solids, other impurities; dehydrating**
LUBE OILS	**Continuous, automatic acid treating**
DISTILLATES	**Acid treating, caustic treating, doctor treating**
FUEL OILS	**Desaponification, ash removal**

(To obtain more data on advertised products see page 1584)

SECOND UOP FLUID CATALYTIC CRACKER FOR BAY PETROLEUM CORPORATION . . . BUILT BY

PRO

CON

On stream July 16, this new UOP Fluid Catalytic Cracking unit at the Denver refinery of Bay Petroleum Corporation is another outstanding construction project successfully completed by Procon.

In addition to building this 3,500 barrel-per-stream day cracker, Procon also revamped polymerization and gas concentration facilities, modernizing existing equipment for increased crude capacity.

This is the second cat cracker built by Procon for Bay Petroleum, the first being at their Chalmette, La., refinery — an open indication of Bay's confidence in Procon's ability to handle the job efficiently and economically.

PROCON *Incorporated*
PROCESS CONSTRUCTION
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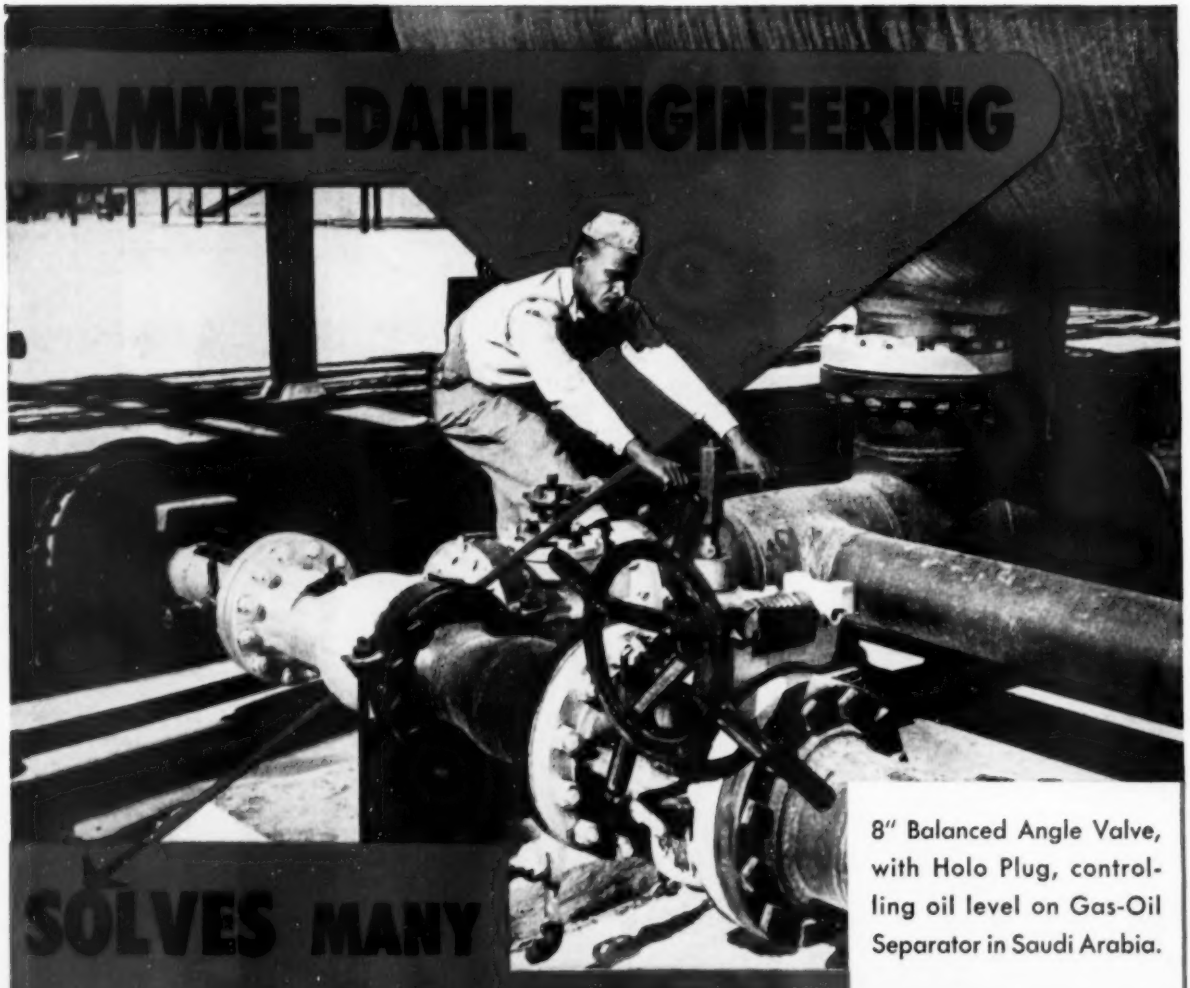
HAMMEL-DAHL ENGINEERING



8" Balanced Angle Valve, with Holo Plug, controlling oil level on Gas-Oil Separator in Saudi Arabia.

SOLVES MANY

ARABIAN AMERICAN OIL COMPANY

difficult control problems which are intensified by—Desert Heat—Sandstorms—Ionization—Remoteness.

Repeat installations in many industries testify to the CONTINUOUS, SAFE, EFFICIENT, and DEPENDABLE PERFORMANCE of Hammel-Dahl Control Valves under the most adverse operating conditions.

Write for your copy of our new Angle Valve Bulletin.

HAMMEL-DAHL COMPANY

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SALES OFFICES IN ALL PRINCIPAL CITIES

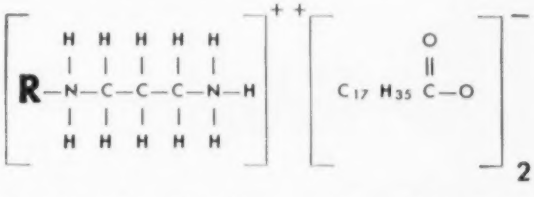
MANUFACTURING PLANTS IN WARWICK, R. I., U. S. A., CANADA, ENGLAND, FRANCE AND HOLLAND

New Armour chemical cuts corrosion costs of primary wells

Major petroleum companies find Duomeen® T Dioleate more effective than dilute inhibitors — and lower in cost!

The latest development of the Armour Chemical Division's petroleum chemists is Duomeen T Dioleate—a potent corrosion inhibitor for "Down the Hole" treatment of primary producing wells. The ability of this new cationic surface active agent to convert steel surfaces from water-wettable to oil-wettable, thus forming a protective film, is the reason for the excellent protection provided by Duomeen T Dioleate.

Manufactured under exacting laboratory specifications, Duomeen T Dioleate is supplied *100% active*—water insoluble but readily soluble in common solvents. Particularly outstanding results have been obtained in controlling acid conditions in sour wells. Laboratory and field tests report 20 ppm of this chemical sufficient to gain maximum effectiveness. While this amount is reported as being successful, it is realized that specific locations and conditions may exist where greater concentrations are necessary. However, since Duomeen T Dioleate is supplied 100% active, it provides great flexibility by permitting the user to meet such conditions by making up any desired solution at the site. Duomeen T Dioleate also has application in other hydrocarbon systems and product lines. For the benefit of engineers who wish to know the chemical structure of this new and unique product, the structural formula for Duomeen T Dioleate is as follows:



Samples and complete data are readily available. Simply fill in and mail the coupon with your letterhead for free samples and a copy of our "Combat Corrosion" bulletin and Technical Bulletin E-6, "Chemical Treatment in Oil Wells."

Mail This Coupon With Your Letterhead

Armour Chemical Division
1355 W. 31st Street, Chicago 9, Ill.

Please send me:

- ☐ Samples of Duomeen T Dioleate
- ☐ "Combat Corrosion"
- ☐ Tech. Bull. E-6, "Chemical Treatment in Oil Wells"

Name .....

Title .....

Firm .....

Address .....

City ..... *Zone* *State*

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ARMOUR CHEMICAL DIVISION

©Armour and Company • 1355 West 31st Street • Chicago 9, Illinois

(To obtain more data on advertised products see page 1584)

What's happened to the more than 1,800 Corrosion-Resistant Coatings introduced

Since 1939

Hard to believe, isn't it, that in less than 15 years more than 1800 brand names of protective coatings have made their market appearance . . .

and disappearance.

Only a relatively few remain.

WHAT HAPPENED?

Many good coatings failed to last because their makers ballyhooed them too highly — practically forced corrosion engineers to use them under conditions where no coating could possibly work.

Many other so-called protective coatings just didn't have it to begin with.

The fact that Tygon Paint — first marketed in 1939 — has grown increasingly popular over the years, stems from two things:

First: it is a good protective coating

Second: we're not afraid to admit its limitations

Used as it should be used and under conditions for which it is suitable, Tygon Paint will outperform and outlast practically any coating on the market. Fifteen years have proved it.

We have one suggestion to make on the use of protective coatings. Write for a copy of Tygon Paint Bulletin 750. Check the performance data against the corrosives listed. If Tygon Paint appears to offer an answer to your corrosive problems — buy a trial quantity — *and test it.*

PLASTICS AND SYNTHETICS DIVISION

FREE BOOKLET ON REQUEST

Tells you just what you can expect from Tygon Paint and Tygorust under the corrosive conditions that exist in your plant. Address Plastics & Synthetics Division, The U. S. Stoneware Co., Akron 9, Ohio.

U. S. STONEWARE

AKRON 9, OHIO

233-D

Burn Low Grade Fuels – Efficiently . . .

The Ljungstrom operates on the continuous regenerative counter-flow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.

. . . with a LJUNGSTROM *air* PREHEATER

Low grade tars, pitches and asphalts used to be considered so low in recoverable heat value that they were often discarded. But the Ljungstrom Air Preheater points the way to the practical, efficient use of these former waste products.

Preheated air is a key factor in more efficient combustion, causing faster ignition and a short, hot flame. Rates of heat liberation are higher, too. Thus, with preheated air, low grade fuels with high ash and moisture content – and excessively lean fuels – are readily burned.

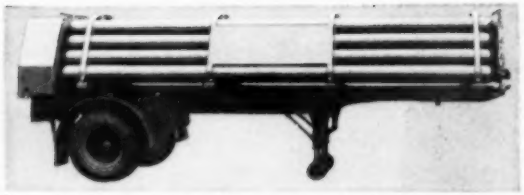
You get other advantages with a Ljungstrom, too: lower fuel costs . . . more economical furnace design . . . greater throughput . . . higher product quality – *all of these with the Ljungstrom, that pays out in just a few months.*

Wherever you are planning to expand or modernize your fuel burning equipment, it will pay you to consider a Ljungstrom Air Preheater. Call or write for full information.

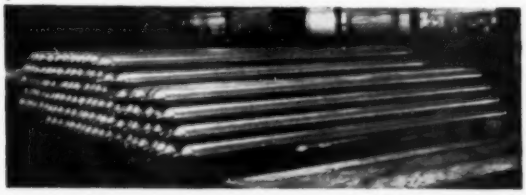
THE AIR PREHEATER CORPORATION
60 East 42nd Street, New York 17, N. Y.

WHEREVER YOU BURN FUEL, YOU NEED LJUNGSTROM

NEW hydrogen transport solves refiners' storage problems



Semi-trailer with 30 or 38 tubes is delivered to point of usage. Capacity of 30 tube unit is 39,000 cu. ft. at 2400 psi; of 38 tube unit, 50,000 cu. ft. at 2400 psi.



Taylor-Wharton can also furnish individual storage cylinders, made to ICC 3A2400 classification and qualifying under API-ASME for 1450 psi.

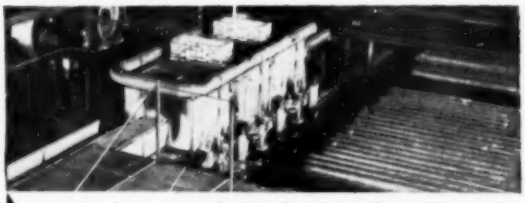
Taylor-Wharton high pressure transports efficiently store and deliver for Allied Chemical & Dye Corporation. High storage capacity and mobility will save handling dollars and floor storage space for you too.

Semi-trailer Mounts 30 or 38 Tubes for Mobile, Compact, High Pressure Hydrogen Storage

In response to hydrogen storage problems faced by new platforming process plants, Taylor-Wharton offers two kinds of high pressure cylinder installations, the permanent and the transport, now successfully used in the chemical industry.

Investigation of high pressure equipment will reveal the economy of this method of storage. (Low pressure storage requires an expensive compressor.) The tubes readily provide a flexible supply of hydrogen to get you "on stream" quickly. High pressure storage saves space, packing up to 50,000 cubic feet of hydrogen at 2400 psi in the transport.

Write now for Bulletin 300 which will show you the economy of Taylor-Wharton cylinders for your hydrogen plant.



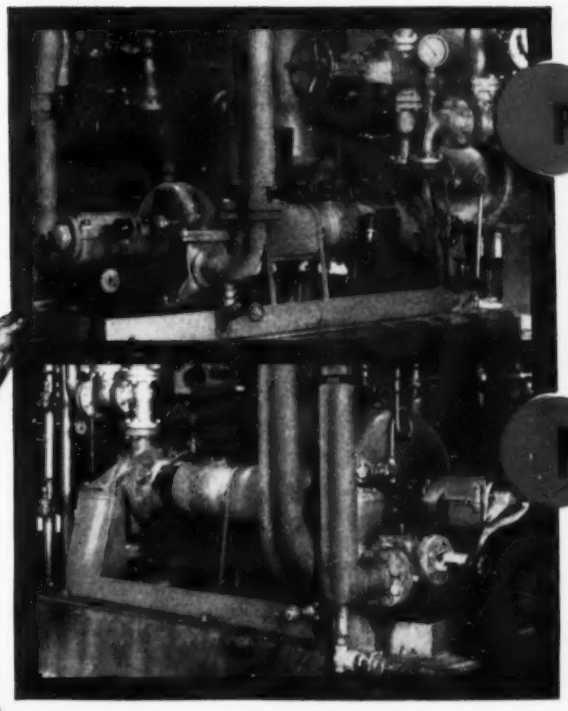
Modern heat treating facilities for tubes at Taylor-Wharton Iron and Steel Company.

ESTABLISHED TW IN 1742

TAYLOR-WHARTON IRON & STEEL COMPANY

CINCINNATI 12, OHIO

Also Manufacturers of: Manganese Steel Castings, Alloy and Carbon Steel Castings, Special Trackwork, Gas Clyinders



POWER!

For Your Small Jobs

Installed in a large southern refinery, this Dean Hill Type DH Steam Turbine efficiently provides all the H.P. needed for driving centrifugal process equipment

MORE POWER!

For Your Big Jobs

1,000 H.P. is available for this process pumping operation (same plant as above). Dean Hill is on the job with this powerful steam turbine.

MOST POWER!

For Your Money With DEAN HILL Turbines

Small and large, Dean Hill Turbines are built to give all the power you need, at less expense. Specifically designed for operation at medium steam pressure. Since they are the single stage, double impact type, low steam consumption is a tremendous economy feature. Most key DH Turbine parts are interchangeable in all sizes of DH Turbines. Write today for full details and specifications.

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Pump and Turbine Engineers Since 1895

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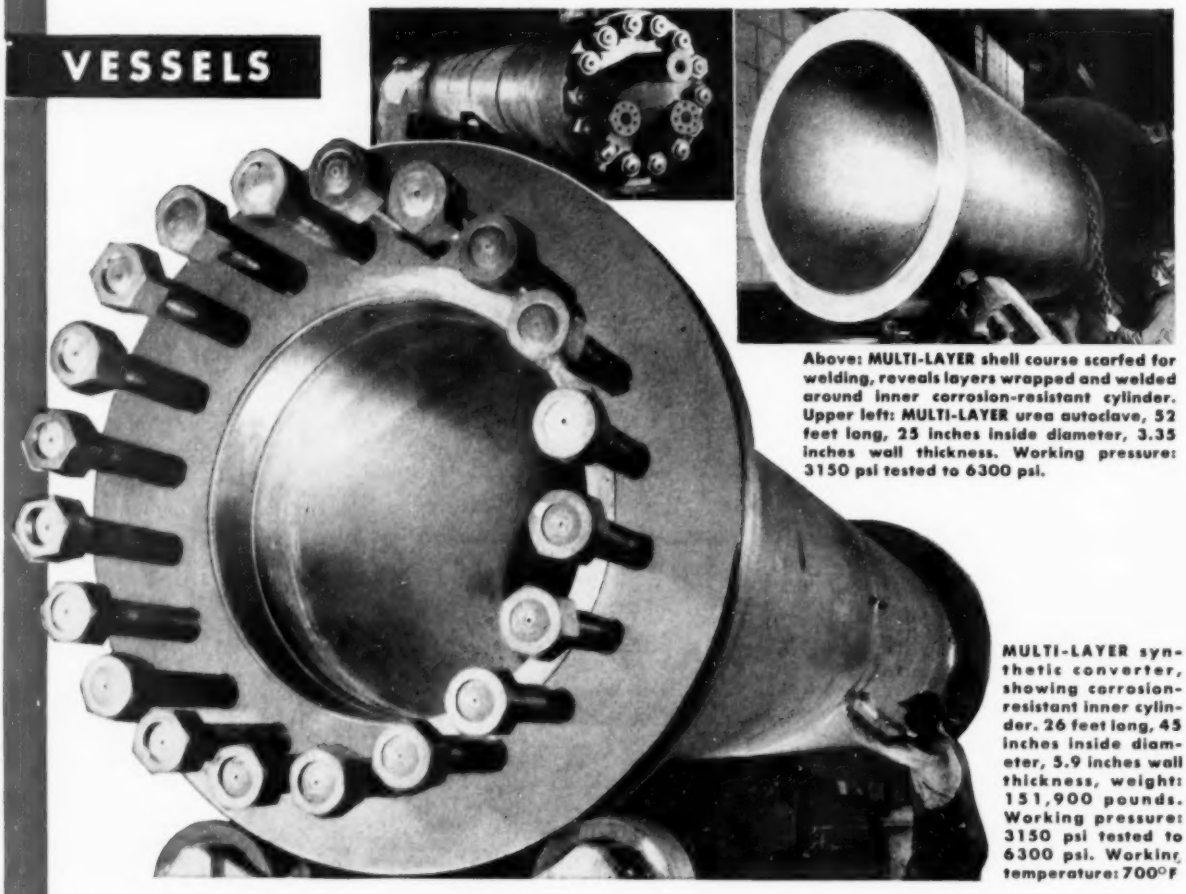
136-S

A.O.Smith for

VESSELS



Above: **MULTI-LAYER** shell course scarfed for welding, reveals layers wrapped and welded around inner corrosion-resistant cylinder. Upper left: **MULTI-LAYER** urea autoclave, 52 feet long, 25 inches inside diameter, 3.35 inches wall thickness. Working pressure: 3150 psi tested to 6300 psi.

MULTI-LAYER synthetic converter, showing corrosion-resistant inner cylinder. 26 feet long, 45 inches inside diameter, 5.9 inches wall thickness, weight: 151,900 pounds. Working pressure: 3150 psi tested to 6300 psi. Working temperature: 700°F

MULTI-LAYER MEETS

The designer's answer to higher pressures, temperatures, and more critical corrosion problems . . . *with safety*

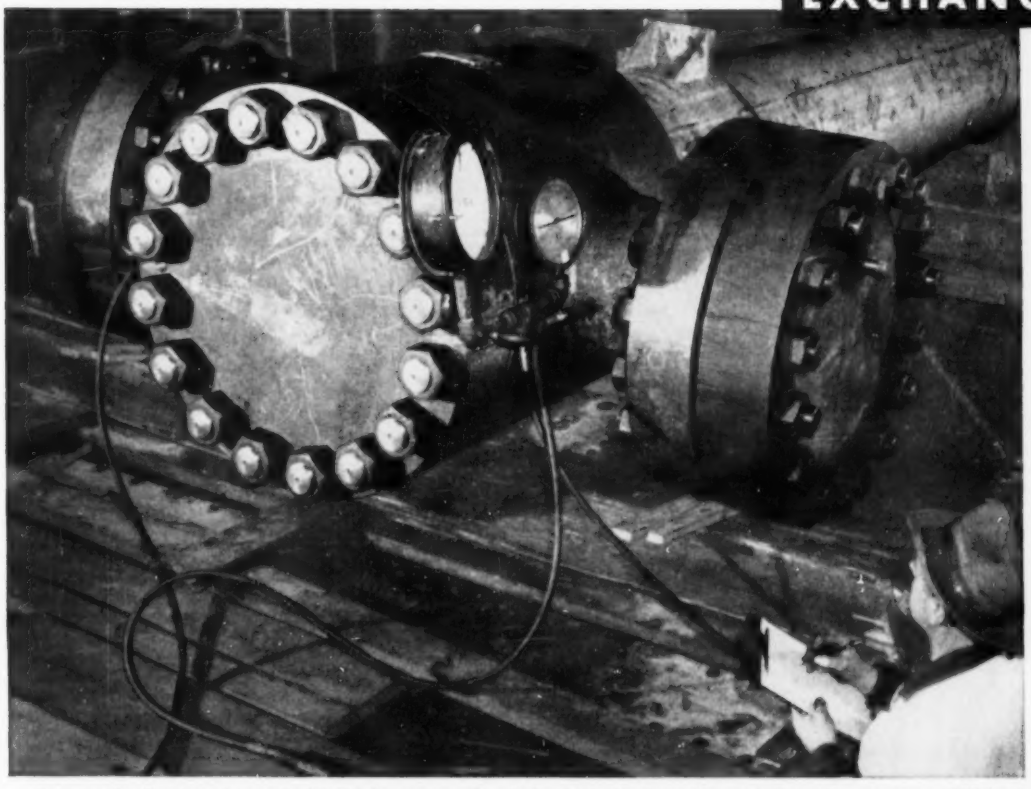
As processing problems become more acute, A. O. Smith MULTI-LAYER construction of vessels and heat exchanger shells becomes more and more important to equipment designers and buyers.

Future requirements of processors are being solved with this time-tested design. MULTI-LAYER inherently satisfies all of the conditions of modern operation: extreme pressures, elevated temperatures, critical corrosion conditions.

Because MULTI-LAYER construction consists of wrapping and welding successive concentric layers of relatively thin steel plate around a central, pressure-tight cylinder, no size or weight limitations are imposed, making it possible to design the vessel to fit the requirements of the process. Since the inner cylinder is pressure-tight, load-bearing layers are provided with vent holes to prevent damage from over pressure and to serve as automatic safety and warning devices in the remote event of

Outstanding Advantages

EXCHANGERS



Inter cooler (heat exchanger) with U-tube construction, being tested before shipment. Operating pressure: 2500 psi.

CHALLENGE of FUTURE

runaway overload. In applications, involving hydrogenation, venting prevents embrittling attack on the load-bearing layers. For corrosive service, the inner cylinder is fabricated of lined or clad plate, alloy steel or non-ferrous material to meet the processing condition.

Bigger batches to effect economies and meet competition in an expanding market can be planned. Advanced processing methods can be implemented. Our own designers, engineers, and research staff will welcome opportunities to assist in adapting MULTI-LAYER vessels and heat exchangers to your needs.

Send for MULTI-LAYER Bulletins: V-52, *MULTI-LAYER Manufacturing and Assembling,* and V-53, *MULTI-LAYER Engineering for Safety.*

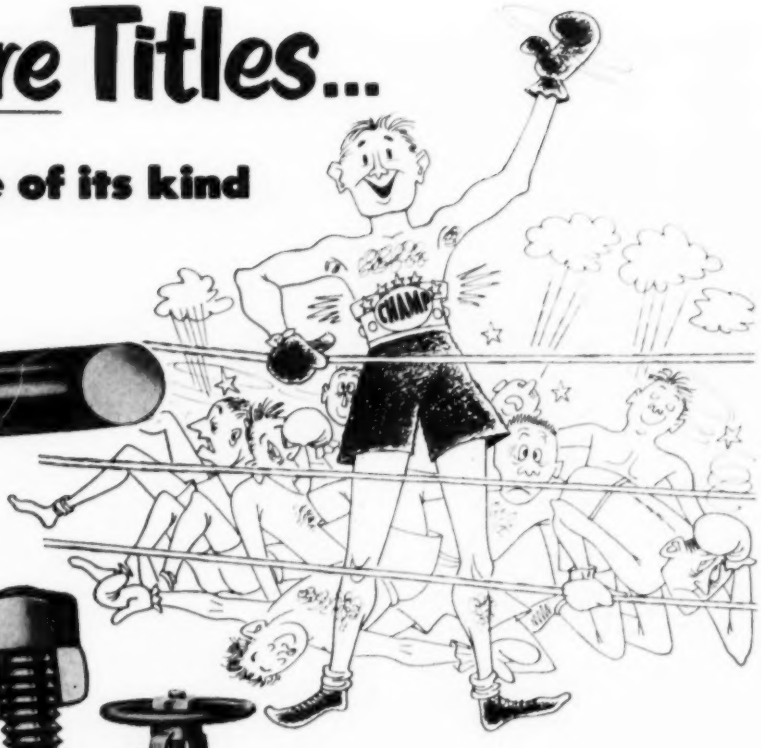
A.O.Smith
CORPORATION

Vessels and Heat Exchangers
MILWAUKEE • HOUSTON
Licensee in Canada: John Inglis Co., Ltd., Toronto
International Division: Milwaukee 1

CHAPMAN LIST 960

Holds More Titles...

than any valve of its kind



Yes, here's the champ of all small forged steel gate valves! It has licked more different jobs than you can shake a stick at . . . and stays in there fighting with all the *extra stamina* you get in *every* Chapman Valve.

Here are the reasons why: Extra protection against even unusual stress when opening and closing the valve is provided by extra-strong stem-and-wedge-gate connection. Repairs and replacements are cut by the use of super-hardened seat rings and gate faces of stainless steel. Forged body and yoke are longer-lived . . . and bolted follower has no threads on yoke to corrode. And lastly, gate faces won't seize or gall because they're *Malcomized* (Chapman patent) to 800 Brinell.

Chapman List 960 Forged Steel Gate Valves are made in sizes from ½" to 2" inclusive . . . with rising stem with yoke (shown) or with rising stem with inside screw. Bonnet joints are either gasketed or metal to metal. Pressure range: 2,000 lb. at 100° F. — 380 lb. at 1,000° F. For higher pressures, specify List 990. And for full details on List 960, send today for your copy of Catalog 10.

THE CHAPMAN VALVE MFG. CO.

INDIAN ORCHARD, MASS.

stop costly screen clogging

SANTOLENE H
Santolene H is Monsanto's new addition agent specifically developed to overcome screen clogging in oil burners.

Here's how Santolene H helps you:

- **ELIMINATES FOGGING** caused by formation or stabilization of fuel oil-water emulsions, since it has a *nonmetallic base.*
- **KEEPS FUEL OIL SLUDGE AND SEDIMENT LOW** by inhibiting progressive polymerization of unstable elements initially present in oil.
- **REDUCES DEPOSITION** of sludge and sediment on burner parts by means of a unique surface action.
- **INHIBITS RUST** and eliminates nearly all entrained rust at fuel oil burner.

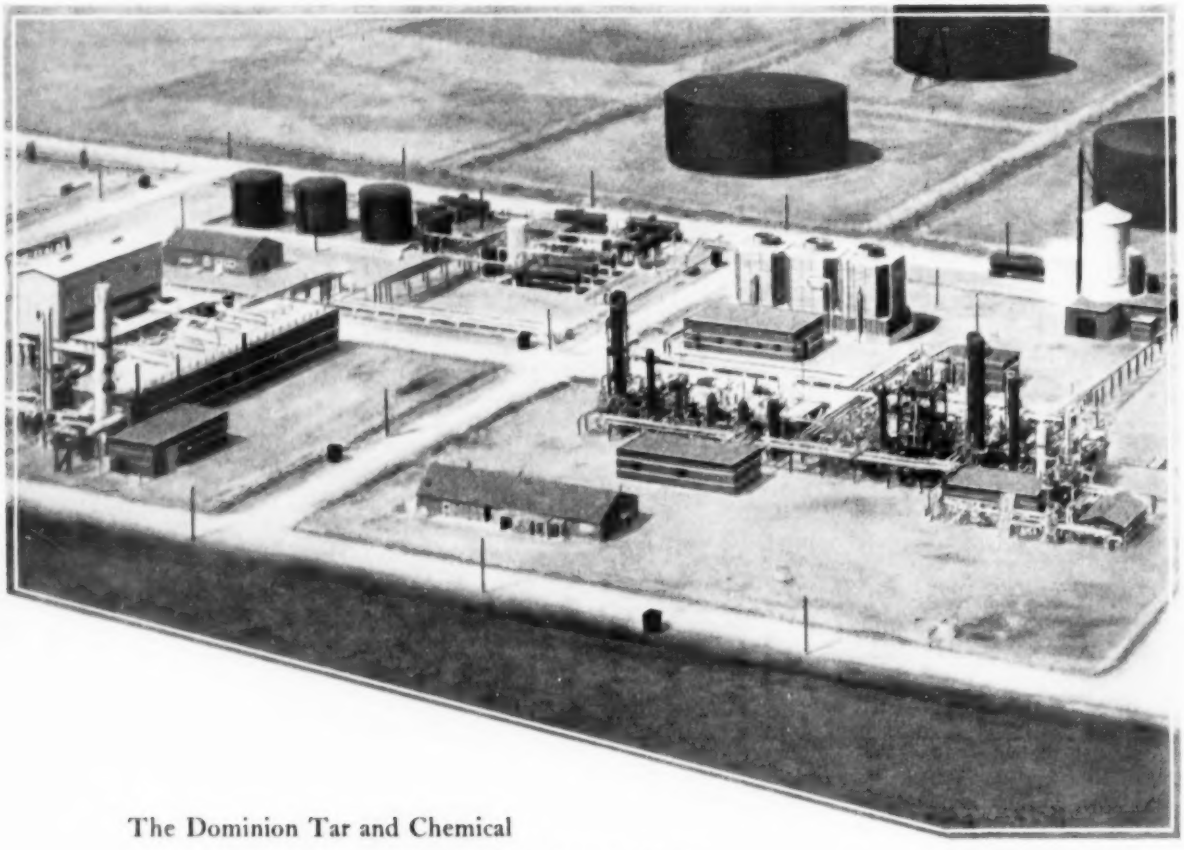
Santolene: Reg. U.S. Pat. Off.

SANTOLENE H

FOR MORE INFORMATION *send for Technical Bulletin O-87. MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 800 North Twelfth Blvd., St. Louis 1, Missouri.*

MONSANTO
CHEMICALS—PLASTICS
SERVING INDUSTRY... WHICH SERVES MANKIND

Chemicals FOR A FAST GROWING REGION



The Dominion Tar and Chemical Company's new plant at Montreal produces ethylene oxide, a component of detergents, solvents and plastics; and glycol, basic chemical in permanent type anti-freeze, explosives and synthetic fibers.

Design and construction of the plant, which has an estimated capacity of 25 million pounds of glycol per year, were by Stone & Webster Canada Limited, utilizing the facilities of Badger Process Division of Stone & Webster Engineering Corporation.

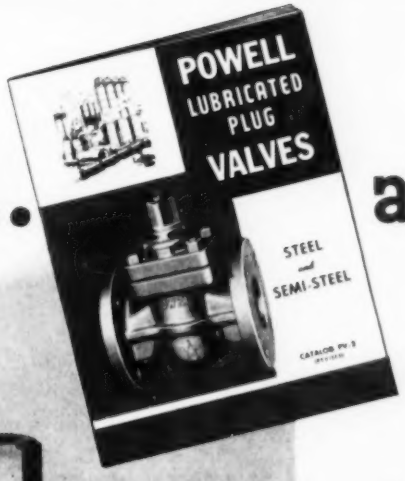
At this plant, located near the St. Lawrence River, Dominion Tar and Chemical Company extracts ethylene from gas piped from nearby refineries, converts it to form ethylene oxide and glycol, and returns the unused gas for further processing.

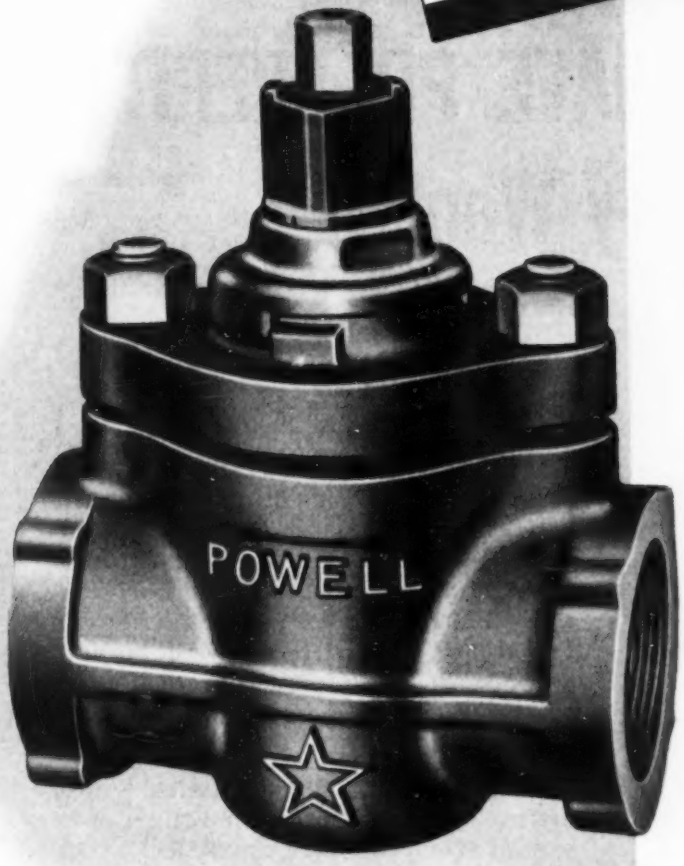
STONE & WEBSTER ENGINEERING CORPORATION

AFFILIATED WITH STONE & WEBSTER CANADA LIMITED

E. B. BADGER & SONS LIMITED

New... and too good to miss!





Now, for the first time, lubricated plug valves that carry the Powell name and measure up to the Powell standards of precision are available in Semi-Steel and Carbon Steel.

You'll want the new PV-2 Catalog in your files. In fact, no valve file can be considered complete without it. And it's so easy to get. Just fill out the coupon below and mail. No charge, no obligation.

As you page through the catalog, you'll see the details that maintain these great new valves in the century-young Powell tradition. Features include quick and positive operation—just a quarter-turn of the Lubricated Tapered Plug to open or close. Lubricant grooves surrounding each port provide a positive seal when the valve is closed. In an open position, seating surfaces are not exposed.

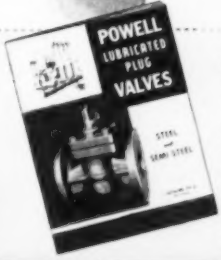
Powell Lubricated Plug Valves are available with Screwed or Bolted Glands. Semi-Steel Valves are available for 175 and 200 pounds W.O.G. Carbon Steel Valves are available for 150 and 300 pounds W.P.

Powell Valves

THE WM. POWELL COMPANY • DEPENDABLE VALVES SINCE 1846 • CINCINNATI 22, OHIO

Free! SEND FOR THE PV-2 CATALOG TODAY

... it's too good to miss!



THE WM. POWELL COMPANY
2504 SPRING GROVE AVE., CINCINNATI 22, OHIO

Gentlemen:

I want to bring my valve file up to date. Please send me a copy of your PV-2 Catalog on Powell Lubricated Plug Valves.

NAME_____ TITLE_____

COMPANY_____

CITY_____ ZONE_____ STATE_____

BRITONS CAN HAVE PROSPERITY —If They Want It

What is required to get Britain, our key ally in the grand alliance of the free world, firmly back on her economic feet? The purpose of this message is to throw light on this crucial problem, which afflicts our other European allies also.

At the moment, Britain is enjoying a respite from the economic crises (of 1947, 1949 and 1951-52) which have plagued her postwar course. This respite may well continue for some time. But almost no one whose judgment is trustworthy believes that Britain has acquired sufficient economic strength to safeguard her against further economic crises in the years immediately ahead.

Two British Views

New and clear light on what should be done to that end has recently been shed by two noteworthy British publications. One is a book, "We Too Can Prosper," by Graham Hutton, distinguished British economic writer and administrator. The other is an article, "The Riddle of Prosperity," published by THE (London) ECONOMIST, Europe's most eminent economic journal.

Combined, these two publications present in sharp relief the basic problem that must be handled successfully if Britain is to be safely solvent. As is implied by its title, ***the Hutton book demonstrates that Britain can be made prosperous by readily feasible procedures, patterned on what has been done in the United States, to increase its industrial efficiency. But, says THE ECONOMIST, with Mr. Hutton's book in mind, this is not the most basic problem, which is, "How shall we make the British people determined to be prosperous?"*** This is a problem of incentive or motivation.

Compared with that of the United States, average industrial efficiency in Britain, as in most of Western Europe, is low. In his book Mr. Hutton remarks that "fifty years ago an American industrial worker turned out roughly the same amount in a day as his opposite number in Britain, Germany or France. . . . Today, he turns out from two to five times as much."

In large part it is this lag in output per hour or "productivity," as the technicians call it, which makes Britain and other key countries in Western Europe a continuing prey to economic crises. Moreover, the great disparity in productivity between the U.S.A. and most

of Western Europe is a major barrier to knitting the free world into a smoothly working economic whole. As one observer put it, "when the American economy catches a cold, the European economy gets pneumonia." This is largely because Europe is so much weaker in productive strength.

No Shortage of Knowledge

Yet the knowledge which would enable the countries of Western Europe, and particularly Britain, to increase their industrial productivity has been mobilized and is readily available to them. It is with this process for Britain that Mr. Hutton's book is concerned. In the book he summarizes the findings and conclusions, virtually all of them unanimous, of 66 teams, composed of British industrial managers, technicians, shop workers and labor leaders. Over a period of three years these teams completed a comprehensive series of inspection and study trips in the United States under the sponsorship of the Anglo-American Council on Productivity. The product of that effort, he remarks, is "a set of documents the like of which, on such a scale and of such practical value, has never been seen in the history of international and cultural borrowing."

Psychology the Key

From study of these documents, Mr. Hutton concludes that better capital equipment is the key technical ingredient of higher industrial productivity in Britain, and constitutes "the most urgent . . . need of British industry." But he finds that ***even without new capital equipment a "15% rise in productivity can still be achieved by reorganization of work," and that such an increase would "solve Britain's chief social and economic problems."***

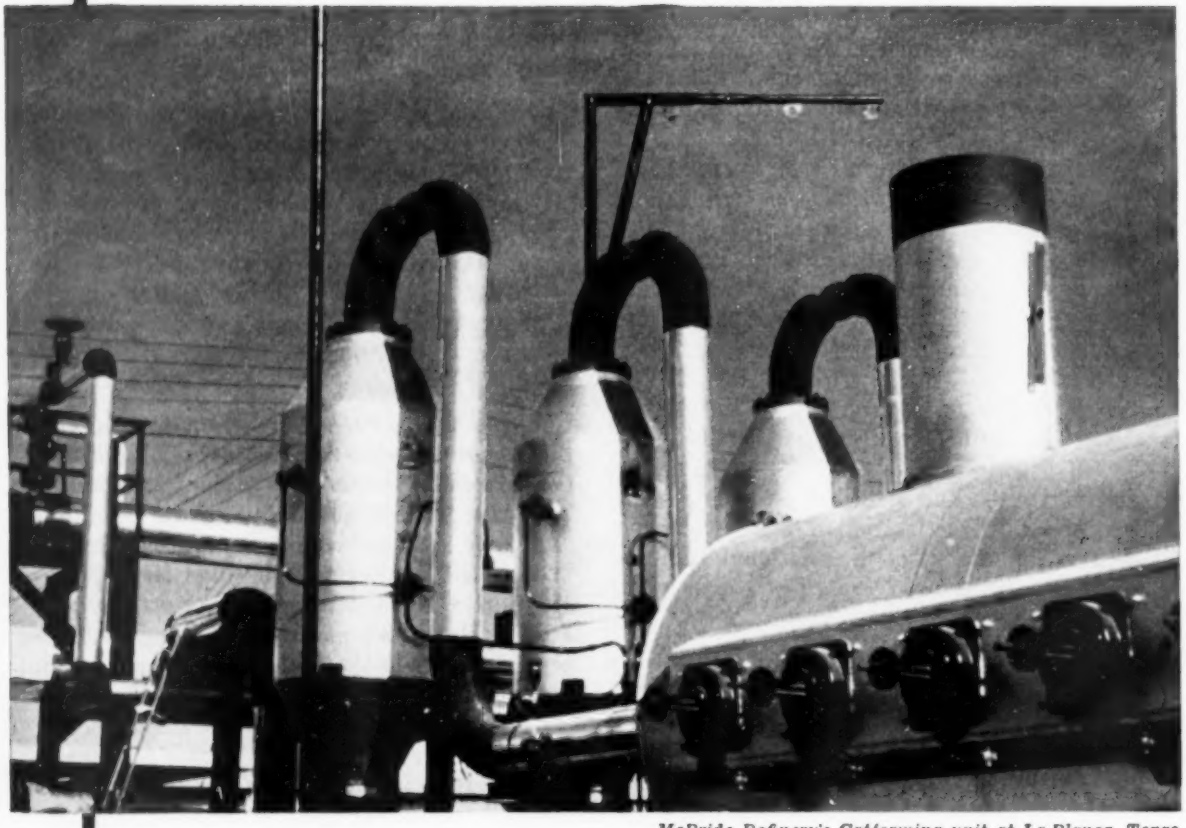
Then why is not such an increase in productivity, demonstrated by the Anglo-American productivity teams to be so clearly within technical grasp, promptly forthcoming? Mr. Hutton, quoting one of the team reports, remarks that, ***"'the greatest obstacles to increased productivity are psychological rather than technical.'*** We have to deal first and foremost with men, not machines." And THE ECONOMIST, pursuing the line of inquiry suggested, reaches the conclusion that, by and large, the people of Britain do not want to prosper by being more efficient. THE ECONOMIST says:

> "The real secret of American productivity is that American society is imbued through and through with the desirability, the rightness, the morality of production. . . . But in Britain, if any moral feeling at all survives about economic matters, it is usually a vague suspicion that economic success is reprehensible and unworthy. From this difference in attitudes everything else follows."

"How," asks THE ECONOMIST, "shall we set about restoring some belief in the rightness of effort, the morality of success?" For this question it has no ready answer. Neither have we. We are confident that the British people will neither be cajoled nor coerced into trying to match our productivity. Basically the problem seems to be to demonstrate clearly to them the truth of the proposition, set down by Graham Hutton, that "there is no goal, aim or end before a Good Society which the raising of that society's material productivity cannot render easier of achievement." Doing that in an old and settled country like Britain is obviously an extremely formidable undertaking. But ***until it is done, the crucial job of getting Britain and the rest of Western Europe firmly on its economic feet will remain to torment all of us.***

McGraw-Hill Publishing Company, Inc.

CATFORMING EXCEEDS ALL



McBride Refinery's Catforming unit at La Blanca, Texas

IN CATALYTIC REFORMING
IT'S THE CATALYST

(To obtain more data on advertised products see page 1584)

PLANT GUARANTEES!

McBride Catformer completes initial run. Here are the startling results:

- In its initial run, all guarantees—including throughput, catalyst life, and yield octane—were exceeded.
- Starting with a 30 octane, C4 to 400° F. end point naphtha, the McBride-reformed gasoline has met final gasoline specifications throughout its entire running.
- No expensive feed preparation or product treating is required.
- The ability to regenerate the catalyst in place has been successfully demonstrated at McBride.

DO YOU HAVE YOUR COPY?

This complete bulletin tells the whole story about Catforming. Make sure you get your copy. Write The Atlantic Refining Company, Research and Development Department, P. O. Box 8138, Phila. 1, Pa. (Telephone HOward 5-2345.)

THAT COUNTS

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Cyanamid
COMPANY

This Westinghouse high-voltage switchgear automatically and rapidly clears trouble at Standard Oil's Lima Refinery. If there's a momentary outage, the load is reapplied in segments.

Westinghouse control centers minimize maintenance problems and give Mississippi Chemical the advantages of grouped control. Individual units can be installed or removed with file-drawer efficiency.

(*To obtain more data on advertised products see page* 1584)

Petroleum and chemical companies confirm:

Westinghouse equipment provides dependability

Our engineers help you get dependability by combining Westinghouse electrical equipment with creative system planning. Here's proof.

Sohio's Lima Refinery got power dependability without paying extra for stand-by capacity. Westinghouse engineers helped develop a power system which provides a fast restoration of service after interruptions. Westinghouse supplied a control system that automatically and rapidly clears trouble. This system successfully handled twelve power interruptions during the first nine months of operation, without loss of refinery production.

Mississippi Chemical officials called on Westinghouse to help them get a complete "packaged installation" with the best electrical equipment at no extra cost. One feature was that Westinghouse control centers were installed in nonhazardous locations throughout the plant. This gave Mississippi Chemical the advantages of centralized control without paying for more expensive explosion-proof equipment.

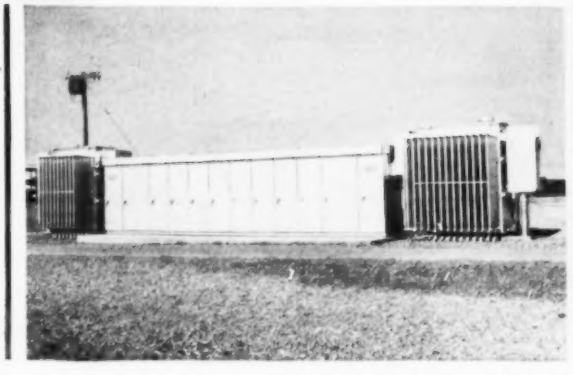
Texaco's Eagle Point Refinery got top-system dependability, efficiency and flexibility for future expansion. Westinghouse turbine-generators supply all the power, but there's also a tie-in with the local utility for emergency purposes. Dual-feeder cables carry power to all Westinghouse outdoor load centers. If one faults, the other can handle the full load. All Eagle Point has to do for any plant expansion is add substation capacity.

American Cyanamid and Westinghouse engineers worked out a power distribution system that prevents outages. If there's trouble on any feeder, power is switched to another. If a substation faults, other substations carry the load through cross connections. This system can be easily and inexpensively expanded as the plant grows.

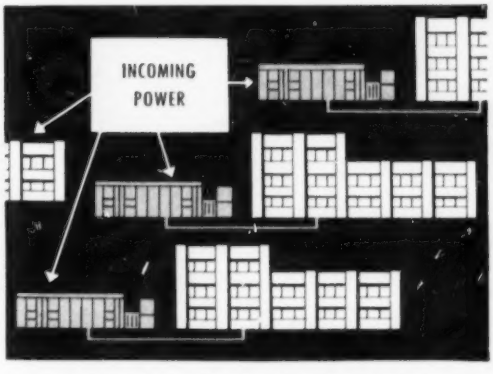
These solutions are only four examples of how Westinghouse equipment and services can meet your power distribution problems. If you'd like more information on the above, or other installations, call your Westinghouse representative. Or write to: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-94992

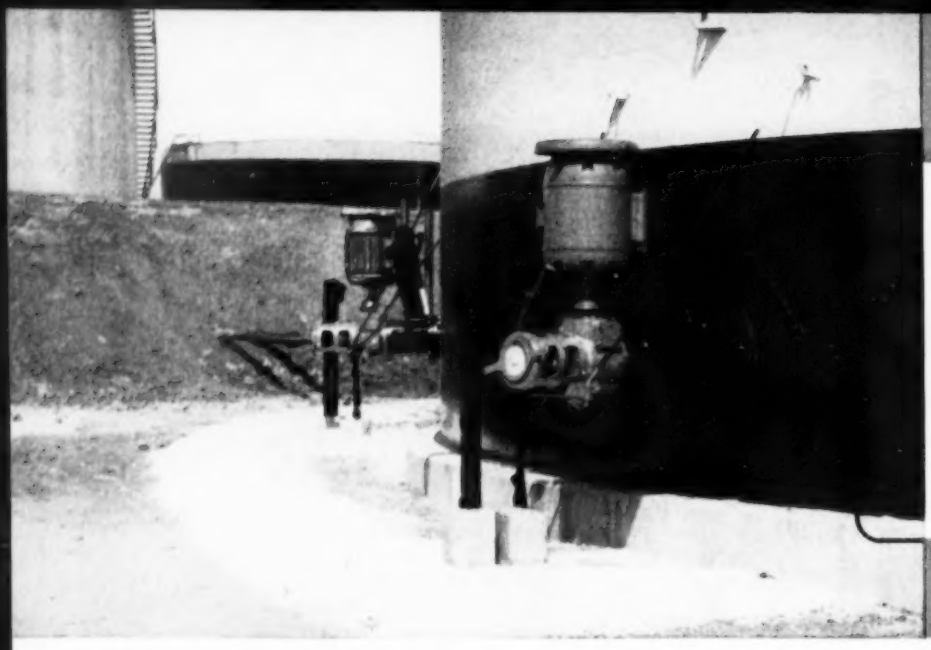
YOU CAN BE SURE...IF IT'S Westinghouse



Eagle Point Refinery's Westinghouse substations are complete with switchgear, transformers and circuit breakers in one, compact arrangement. The system is highly flexible and dependable.



American Cyanamid spotted 10 substations throughout the processing area. When new buildings are added, additional substations will be installed without interfering with production.



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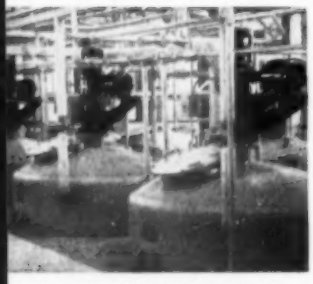

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PETROLEUM PROCESSING
OCTOBER, 1953

If You Build a 40,000 b/d Refinery:

	with COMBINATION PROCESSING	instead of INDIVIDUAL UNITS	YOU SAVE
Investment in Process Units	$11,800,000	$12,600,000	$ 800,000
Investment in Offsite Facilities	8,900,000	14,000,000	5,100,000
Total Investment	20,700,000	26,600,000	5,900,000 (22.1%)
Investment/bbl	517	665	148
Operating Cost/bbl	44.8c	49.5c	4.7c (9.5%)

Combination Processing Can . . .

Cut 22% off Investment Costs

By N. R. ADAMS and W. J. PRICE
M. W. Kellogg Co., New York

REFINERS today can cut 22% off the capital investment required to build a new 40,000 b/cd complete refinery by employing combination processing instead of putting up a group of separately operated individual units.

In addition, they can reduce the operating costs of that plant by about 9.5%.

Similar savings can be realized in smaller sized plants. A 20,000 b/cd combination refinery would cost 20% less to build and 11% less to operate than a conventional plant with separate operating units. For a 10,000 b/d refinery, the savings would be 22% on investment and 13.5% on operating costs.

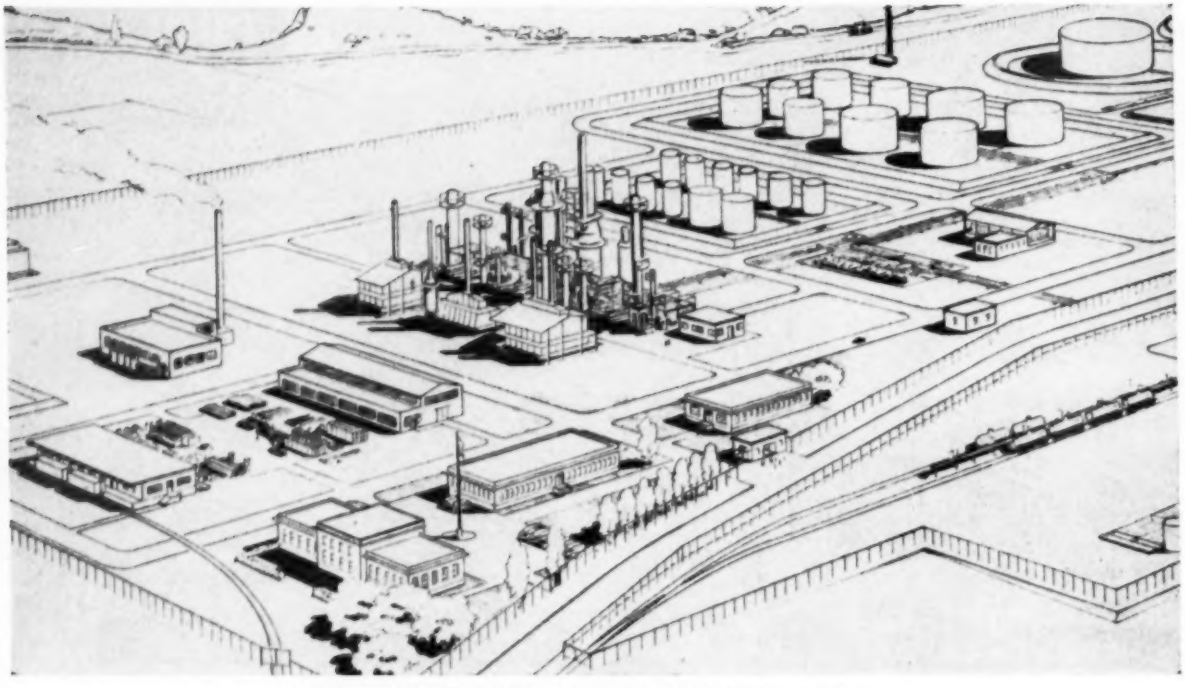
What Combination Processing Is

In order to explain more fully the term "combination processing," it is first necessary to visualize a conventional or non-combination refinery as consisting of a series of individual processing units, each one independently operated and separately controlled. The plant is complete with intermediate storage for partially processed products, transfer piping and pumps to move these semi-finished products to and from storage, and heat exchangers to maintain a reasonable heat balance in the plant.

Combination processing, on the other hand, utilizes the same processes—but in an integrated, interdependent and centrally controlled processing sequence. Intermediate storage for partially finished products is either greatly reduced or eliminated entirely, and there is continuous flow from one operation to the next.

The basic economies which result from combining four, five and even more process steps into a single, centrally controlled operation include those stemming from lower capital investment, lower operating costs and better yields—the latter due to reduction of evaporation and other losses.

All of these points can be related to the process equipment involved, but even this is not the whole story by any means. Very roughly, refiners employing sequence type unit operations have for years been spending about as much capital for off-site facilities as they have for the process equipment itself. Today, it is possible by well integrated combination processing not only to cut the cost of processing equipment from 5 to 15%, but to reduce the ratio of the cost of off-site facilities to process units from about 100% to a value of approximately 70 to 75%.



COMBINATION PROCESSING REFINERY eliminates intermediate tankage, centralizes manufacturing activities, while in . . .

The overall combined effect results in the potentiality of being able to erect complete new combination type oil refineries at perhaps 80% of the cost of building comparable equipment incorporating numerous individual process units. While the above investment figures are very general, they do serve to emphasize one aspect of the financial significance of utilizing the most modern types of petroleum processing.

The idea of combining unit operations is not a new one. It was widely accepted by refiners as early as 1930, and it might even be a bit difficult to establish just when and where the first step in this direction was achieved. The important point, however, is that the development of many new refining processes in recent years has brought about the opportunity to incorporate successfully improved methods into overall integrated plants. Noticeable among such new processes are catalytic cracking, catalytic reforming, solvent decarbonizing, continuous coking and others.

What Are the Figures?

Leaving the broader aspects of the subject for a moment, it would seem of general interest to set up specific even though hypothetical refinery cases and study in some detail the various elements of the cost involved. Suppose, for example, it is assumed that one is interested in the refining of a typical low sulfur paraffinic crude oil such as East Texas, and that the products required are motor gasoline, kerosine, No. 2 heating oil, and bunker fuel oil. A logical processing sequence might well be topping, vacuum distillation, recycle fluid catalytic cracking, catalytic polymerization, catalytic reforming and gasoline treating. A normal overall yield structure for such an operation would be approximately as shown in Table 1.

Process equipment capacity for a refinery charging 10,000 b/cd of crude would necessarily be about as indicated below:

Crude topper and vacuum flasher—10,000 b/cd.

Fluid catalytic cracker and gas recovery unit—4600 b/cd fresh feed (6250 b/cd reactor thruput).

Fixed-bed platinum catalytic reformer—1500 b/cd.

Catalytic polymerization Unit—299 b cd polymer product.

Gasoline and kerosene sweetening capacity—7141 b/cd.

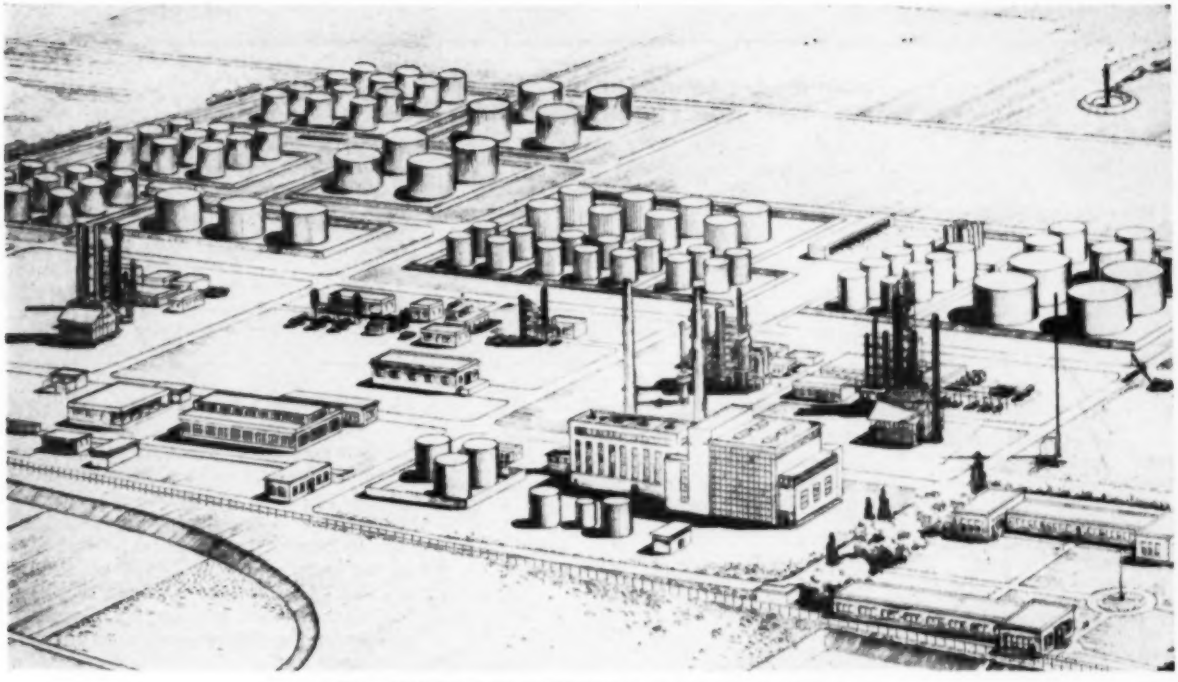
Let us further assume that we wish to study the economic aspects of combination versus individual sequence refining operations in terms of crude running capacities of 10,000, 20,000 and 40,000 barrels per calendar day.

Of immediate interest are the investment requirements to produce the results indicated above. For purposes of orientation, with special emphasis on maintaining all cases on a strictly comparable basis, the figures in Table 2 are suggested. It should be pointed out that in selecting East Texas crude,

Table 1—Overall Yield Structure

	East Texas Crude	Total Gasoline Pool	Premium Gasoline	Regular Gasoline	Kerosene	No. 2 Furnace Oil	Fuel Oil	Fuel Gas	Coke (Non-Recoverable)
Vol. % on Crude	100.0	61.4	21.5	39.9	10.0	12.9	11.2	5.2*	—
BPCD	10,000	6141	2149	3992	1000	1290	1120	516*	—
Gravity, °API	38.4	59.8	59.8	59.8	41.8	29.4	11.0	—	—
Wt. % on Crude	—	—	—	—	—	—	—	4.9	3.7
RVP	—	10.0	10.0	10.0	—	—	—	—	—
Octane Number:									
CFR-R (cl)	—	81.8	—	—	—	—	—	—	—
CFR-R+2.0cc TEL/gal.	—	89.8	—	—	—	—	—	—	—
CFR-R+2.7cc TEL/gal.	—	—	95.0	—	—	—	—	—	—
CFR-R+1.6cc TEL/gal.	—	—	—	87.0	—	—	—	—	—
Viscosity: SFS @122°F	—	—	—	—	—	—	300	—	—

* Fuel Oil Equivalent



INDIVIDUALIZED UNIT OPERATION of same approximate capacity, tankage and processing units are sprawled over wide area

an ideal feed stock is under consideration. Little corrosion protection is required, and treating costs are low. In the refining of sour crudes, both investment and operating costs would be increased.

The investments tabulated in Table 2 show that savings in capital costs occur principally in the off-site facilities. The largest single reduction in investment is realized by eliminating the intermediate storage capacity and its piping. Consolidation of buildings both in the process and off-site facilities also cuts costs. By placing the different processes as close as possible to the central control house, it is further possible to reduce the costs of roads, fences, utility piping and facilities, temporary services and construction facilities, and construction equipment and costs.

The next element of financial importance to consider could very well be the direct operating cost. To this end there are listed in Table 3 approximate refinery operating costs broken down into the generally accepted categories of battery limit (direct process) costs and other refining costs identified herein as general refining expense. By way of explanation, the former figures include such items as operating labor, fuel, power, steam, water, compressed air, maintenance (labor and material), royalties and all chemicals, catalysts and general supplies normally consumed within the process area limits. The general refinery expense item includes all other direct charges except depreciation, interest, property taxes and insurance. For purposes of simplification, the latter items will be handled in this report as if in a separate category and treated as a function of refinery investment. With the above brief explanation the refinery operating costs previously referred to should be approximately as shown in Table 3.

Although there are savings in utilities and maintenance charges, the largest reduction in direct operating costs for combination units is derived from smaller labor requirements. The estimated total refinery pay roll for all cases is presented in Table 4, and the advantage of combination over individual type units in minimizing labor charges is clearly illustrated.

Having covered investment and operating cost requirements, as well as yields, there needs to be supplied only raw material costs and finished product values to complete all of the elements necessary for an overall economic evaluation of the basic problem. Such a study has been carried out and is presented in Table 5 assuming current U. S. eastern seaboard prices for both crude oil of the specified quality and for all finished petroleum products.

Since many refiners are interested in economic studies where fuel oil prices are lower with relation to gasoline than on the eastern seaboard and where competition with low cost natural gas affects the value of refinery gas for use as fuel, there has been included in the report a study reflecting U. S. Gulf Coast conditions relating to crude oil costs, product price structure, etc. This study is shown as Table 6.

The overall economic summaries shown in Tables 5 and 6 clearly point out the financial advantages to be gained by employing combination processing type refineries. Savings in direct operating costs and investment

Table 2—Approximate Investment Requirements

Type of Operation	Capacity b/cd	Process Only	Off-site Facilities	Total	Investment/BPCD Crude
Combination	10,000	$ 5,200,000	$ 3,900,000	$ 9,100,000	$ 910
Combination	20,000	7,800,000	5,900,000	13,700,000	685
Combination	40,000	11,800,000	8,900,000	20,700,000	517
Ind. Units	10,000	5,500,000	6,200,000	11,700,000	1170
Ind. Units	20,000	8,200,000	9,000,000	17,200,000	860
Ind. Units	40,000	12,600,000	14,000,000	26,600,000	665

Table 3—Direct Refinery Operating Costs for East Coast and Gulf Coast Areas

Type of Operation	Capacity b/cd	Process Only East $c/d	Process Only Gulf $/cd	General Refinery Expense East $/cd	General Refinery Expense Gulf $/cd	Total Operating Costs East $/cd	Total Operating Costs East c/bbl.	Total Operating Costs Gulf $/cd	Total Operating Costs Gulf c/bbl.
Combination	10,000	5,632	4,746	785	785	6,417	64.2	5,531	55.3
Combination	20,000	9,544	7,890	1,050	1,050	10,594	53.0	8,940	44.7
Combination	40,000	16,550	13,460	1,370	1,370	17,920	44.8	14,830	37.1
Ind. Units	10,000	6,495	5,521	921	921	7,416	74.2	6,442	64.4
Ind. Units	20,000	10,663	8,826	1,264	1,264	11,927	59.6	10,090	50.5
Ind. Units	40,000	18,082	14,653	1,733	1,733	19,815	49.5	16,386	41.0

Table 4—Total Refinery Personnel— Combination Processing vs. Individual Units

Plant Capacity, b/cd	10,000		20,000		40,000	
Type Operation	Combination	Individual Units	Combination	Individual Units	Combination	Individual Units
Operating Dept.*						
Combination Unit	35	—	43	—	51	—
Topping and Vacuum	—	15	—	18	—	20
Catalytic Cracking and Gas Recovery	—	24	—	28	—	33
Catalytic Reforming	—	9	—	9	—	14
Catalytic Polymerization	—	9	—	14	—	14
Gasoline and Kerosine Treating	5	5	8	8	10	10
Pumping, Gauging and Ethyl Blending	9	14	11	18	14	23
Boiler House and Water Supply	14	14	19	19	24	24
TOTAL OPERATING	63	90	81	114	99	138
Maintenance Dept.*	54	75	70	95	85	115
Supervisory, Clerical and Service	40	41	51	54	62	68
TOTAL REFINERY PERSONNEL	157	206	202	263	246	321

* Including Foremen

increase the earning potential of an integrated unit to 1½ to 2 times the return expected of a refinery made up of individual units.

It is also interesting to note the effect of plant capacity on earnings. On the Gulf Coast where competition is particularly keen, for instance, construction of a refinery to process only 10,000 b/cd of crude would hardly be considered. Plants to handle 20,000 to 40,000 b/cd crude, however, show attractive returns. A small combination refinery on the East Coast would have a reasonable payout, although it probably would not be advisable to consider a plant much smaller than a 10,000 b/cd refinery of the individual unit type.

In regions isolated and less competitive than either the eastern seaboard or Gulf Coast, a plant to refine 10,000 b/cd crude or even less would probably offer a much better return on investment than has been shown in Tables 5 and 6. In any event, a combination processing sequence would maintain the economic advantage over a plant composed of individual units.

Objections to Combination Processing

In general, the advantages to be gained in combination type processing far outweigh the objections raised by refinery operators, but it may be worthwhile to bring out some of the design considerations checked most carefully by refiners who are interested in building combination units.

One of the most important points to be resolved concerns turnarounds on the refinery equipment. In combination refineries which were constructed for a minimum investment and employ total integration including maximum heat exchange between the different processes, it is usually necessary to bring all the equipment off stream at one time to perform routine inspection and maintenance work. With the reduced amount of labor available in refineries employing combination type processing, either outside maintenance personnel must be available for short periods in order to facilitate fast turnarounds or the plant must stay off stream for longer periods than found necessary in individual unit type refineries.

Proper design of the integrated unit along with a small quantity of "floating" auxiliary storage capacity will, however, allow the refiner to stagger the inspection and maintenance schedule on the various unit processes in order to keep some of the equipment on stream at all times. The problems of maintenance and time off stream can, therefore, be solved without increasing the investment appreciably above the minimum or changing the direct operating costs significantly.

Another frequently mentioned objection to combination units involves the effect of operational upsets on the various processes. It has been pointed out often that unstable operation on one unit will be reflected in the control of other dependent processes. Modern instrumentation, which affords continuous recording and graphic presentation of the process operations at a central control panel along with the automatic control of process conditions, has essentially eliminated any trouble in operating and controlling modern combination units to the extent that operational upsets are of little consequence.

Many refiners and operators are also concerned with the possible extent of damage to an integrated refinery should fire or other disaster strike. Since all of the units are closely concentrated around the control house, this is, of course, a very important consideration. It is felt, however, that the proper physical layout of equipment, good materials and fireproofing, better methods of combating unusual incidents, and carefully scheduled inspections minimize such problems to the degree that the refiner can no longer seriously object to combination units.

Why the Delay in Acceptance?

A question frequently asked is "Why, if combination processing was accepted so long ago, hasn't it been more widely adopted?" The answer to that lies in part with the rapid developments in processing technology

Table 5—Overall Economic Summary—U.S. East Coast

		Capacity—10,000 b/cd				Capacity—20,000 b/cd				Capacity—40,000 b/cd			
		Combination Processing		Individual Units*		Combination Processing		Individual Units*		Combination Processing		Individual Unit*	
Product Credits	**Unit Value**	**BPCD**	**$/Day**	**BPCD**	**$/Day**	**BPCD**	**$/Day**	**BPCD**	**$/Day**	**BPCD**	**$/Day**	**BPCD**	**$/Day**
Premium Gasoline	$0.157/Gal.	2149	14,171	2114	13,940	4298	28,341	4228	27,879	8596	56,682	8456	55,759
Regular Gasoline	$0.143/Gal.	3992	23,976	3927	23,586	7984	47,952	7854	47,171	15,968	95,904	15,708	94,342
Kerosine	$0.1135/Gal.	1000	4,767	1000	4,767	2000	9,534	2000	9,534	4000	19,068	4000	19,068
No. 2 Heating Oil	$0.1035/Gal.	1290	5,608	1290	5,608	2580	11,215	2580	11,215	5160	22,431	5160	22,431
Fuel Oil	$2.35/Bbl.	1120	2,632	1120	2,632	2240	5,264	2240	5,264	4480	10,528	4480	10,528
Fuel Gas (F.O.E.)	$2.35/Bbl.	516	1,213	516	1,213	1032	2,425	1032	2,425	2064	4850	2064	4,850
TOTAL CREDITS			52,367		51,746		104,731		103,488		209,463		206,978
Debits													
Crude Cost Delivered	$3.46/Bbl.		34,600		34,600		69,200		69,200		138,400		138,400
Total Refinery Operating Costs			6,417		7,416		10,594		11,927		17,920		19,815
Depreciation on Process Equipment @ 10%			1,425		1,507		2,137		2,247		3,233		3,452
Depreciation on Offsite Facilities @ 5%			534		849		808		1,233		1,219		1,918
Interest @ 4%			997		1,282		1,501		1,885		2,268		2,915
Property Taxes & Insurance @ 3%			748		962		1,126		1,414		1,701		2,186
TOTAL DEBITS			44,721		46,616		85,366		87,906		164,741		168,686
Net Credits—$/Day			7,646		5,130		19,365		15,582		44,722		38,292
Net Credits—$/Year			2,790,790		1,872,450		7,068,225		5,687,430		16,323,530		13,976,580
Total Refinery Investment—$			9,100,000		11,700,000		13,700,000		17,200,000		20,700,000		26,600,000
Yearly Net Return, Percent on Total Investment**			30.7		16.0		51.6		33.1		78.9		52.5

* Gasoline yields for all of the individual process cases have been debited by one volume percent yield basis crude to allow for incremental evaporation losses.

** Before Federal Corporation Taxes, but after all fixed charges including depreciation.

Table 6—Overall Economic Summary—U.S. Gulf Coast

		Capacity—10,000 b/cd				Capacity—20,000 b/cd				Capacity—40,000 b/cd			
		Combination Processing		Individual Units*		Combination Processing		Individual Units*		Combination Processing		Individual Units*	
Product Credits	**Unit Value**	**BPCD**	**$/Day**	**BPCD**	**$/Day**	**BPCD**	**$/Day**	**BPCD**	**$/Day**	**BPCD**	**$/Day**	**BPCD**	**$/Day**
Premium Gasoline	$0.137/Gal.	2149	12,365	2114	12,164	4298	24,731	4228	24,328	8596	49,461	8456	48,656
Regular Gasoline	$0.123/Gal.	3992	20,623	3927	20,287	7984	41,245	7854	40,574	15,968	82,491	15,708	81,148
Kerosine	$0.100/Gal.	1000	4,200	1000	4,200	2000	8,400	2000	8,400	4000	16,800	4000	16,800
No. 2 Heating Oil	$0.0925/Gal.	1290	5,012	1290	5,012	2580	10,023	2580	10,023	5160	20,047	5160	20,047
Fuel Oil	$1.95/Bbl.	1120	2,184	1120	2,184	2240	4,368	2240	4,368	4480	8,736	4480	8,736
Fuel Gas (F.O.E.)	$0.60/Bbl.	516	310	516	310	1032	619	1032	619	2064	1,238	2064	1,238
TOTAL CREDITS			44,694		44,157		89,386		88,312		178,773		176,625
Debits													
Crude Cost Delivered	$3.05/Bbl.		30,500		30,500		61,000		61,000		122,000		122,000
Total Refinery Operating Costs			5,531		6,442		8,940		10,090		14,830		16,386
Depreciation on Process Equipment @ 10%			1,425		1,507		2,137		2,247		3,233		3,452
Depreciation on Off-site Facilities @ 5%			534		849		808		1,233		1,219		1,918
Interest @ 4%			997		1,282		1,501		1,885		2,268		2,915
Property Taxes & Insurance @ 3%			748		962		1,126		1,414		1,701		2,186
TOTAL DEBITS			39,735		41,542		75,512		77,869		145,251		148,857
Net Credits—$/Day			4,959		2,615		13,874		10,443		33,522		27,768
Net Credits—$/Year			1,810,035		954,475		5,064,010		3,811,695		12,235,530		10,135,320
Total Refinery Investment—$			9,100,000		11,700,000		13,700,000		17,200,000		20,700,000		26,600,000
Yearly Net Return, Percent on Total Investment**			19.9		8.2		37.0		22.2		59.1		38.1

* Gasoline yields for all of the individual process cases have been debited by one volume percent yield basis crude to allow for incremental evaporation losses.

** Before Federal Corporation Taxes but after all fixed charges including depreciation.

brought about by the second World War.

When the war broke out, it became necessary to undertake a sizable expansion program in the petroleum industry to supply the urgently needed aviation and motor gasolines and other products to meet our critical wartime requirements. Production in quantity at the earliest possible moment became all important, and competition became a secondary consideration.

It had become quite apparent that catalytic cracking offered the best method for producing large quantities of high octane gasoline although the process was relatively new and untried. Designers also recognized the fact that numerous problems would arise in putting the catalytic crackers into commercial operation, and that many new improvements and developments were yet to be made in the field of catalytic cracking. This caused designers generally to isolate such units.

Besides installing many catalytic cracking units, refiners found similarly that other new processes such as catalytic reforming, catalytic polymerization, alkylation and isomerization were required to furnish high octane gasoline for wartime use.

Thus, the petroleum industry was faced with the problem of utilizing many new processes to meet abnormally high production rates and the uncertainty as to the ability of a peace time economy to absorb the production from the new units. Under the conditions that existed combination type processing was hardly feasible, and the refining industry necessarily turned to individual type processing units for the duration of the war.

Revival of Combination Processing

The return of a competitive and more stable market after World War II once again caused refiners to think in terms of reducing capital investments and operating costs through the integration of unit processes. The experience gained in combination processing before the war along with the vast knowledge obtained in catalytic processes during the war made it possible to incorporate operations such as catalytic cracking into combination refineries which offered high stream efficiency, excellent flexibility in operation and product distribution, and low initial investment and operating costs.

The post-war building programs included numerous combination thermal cracking refineries in both South America and Europe, and these combination units were typical of the thermal units constructed in the United States prior to World War II. Most of the modern combination cracking schemes included atmospheric topping, vis-breaking, recycle gas oil cracking, thermal reforming and gas recovery. All of the units known to the authors have operated quite satisfactorily, and stream efficiencies on the order of 90% are easily maintained. Excellent flexibility in product distribution has been obtained, and the refiners are reporting low direct operating costs.

In the United States and Canada, there has also been some post war construction of new combination refineries, as well as expansion and modernization programs which integrated existing units with new facilities. One refiner, for example, installed a combination topping-solvent decarbonizing unit along with a new catalytic cracker-catalytic polymerization unit in modernizing and expanding his existing thermal cracking refinery.

At another location a refiner built a completely new integrated refinery consisting of atmospheric topping, delayed coking, fluid catalytic cracking, thermal cracking and gas recovery facilities. Still another operating company incorporated various processes including catalytic cracking in a completely integrated plant.

All of these units have operated very successfully to obtain the advantages claimed for combination units. Currently a very large modern combination type refinery of unique design is under construction in the U. S. The reasons behind the above indicated trend are rather obvious—and mainly financial.

Outlook for the Future

The petroleum industry today is faced with a highly competitive market, and this situation is almost certain to continue in the future. In order to cope with the increasing competition, refiners have one outstanding tool—combination processing.

Savings in both investment and operating costs when utilizing integrated refineries have been demonstrated, and the present trend towards combination units shown by the refinery planning now in progress indicates that most, if not all, of the future refining capacity will be of the combination type.

Acknowledgement

The authors wish to express appreciation to The M. W. Kellogg Co. for permission to publish this paper. Thanks are also extended to Mr. W. P. Given and others who assisted in the preparation.

Meet the Authors

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Mr. Price

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Two Successful Analyzer Samplers

They lick the problem of delivering representative samples to continuous process stream analyzers

By B. W. THOMAS and R. L. MARTIN
Humble Oil & Refining Co., Baytown, Texas

IN the installation of each continuous plant analyzer unique problems are encountered in supplying a test sample continuously suitable for the instrument and consistently representative of the process stream being analyzed.

Factors requiring particular attention for vapor phase analyses include pressure, temperature, flow rate, relative vapor pressures of mixture components, and checking of analyzer sensitivity and drift. All installations must be made according to established safety codes for the area of operation. It is the purpose here to describe two specific systems with which satisfactory performance of continuous plant analyzers may be achieved and to discuss practical means by which some of the attendant problems were overcome.

One sampling system was designed to furnish gaseous test samples to one analyzer from three process liquid streams and a liquid reference mixture, 15 minutes each, per hour. The three streams represented parallel process operations and each stream contained the same three hydrocarbons in varying concentrations. Density for the three components ranged from 0.6 to 0.63 gms/ml and their boiling points ranged from 14 to 18° F.

It was the purpose of the analyzer to measure one component only in the range of 0 to 20 mol per cent. Because of the boiling point difference between the lightest and heaviest component in this stream, precautions were exercised to prevent fractionation during conversion of liquid phase products to vapor phase test samples. A laboratory-analyzed portion of one of the plant streams was found satisfactory for use as a reference test sample in this system.

The other sampling system was arranged to furnish test samples to three separate analyzers from one process stream. In addition, one analyzer was equipped for automatic 15-minute test periods on a reference sample once every three hours. Five different hydrocarbons and one nonhydrocarbon were contained in the process stream being monitored by the three analyzers. Densities of the several components in this stream ranged from 0.6 to 0.9 gms/ml and their boiling points ranged from −10 to +93° F. Two of the analyzers were selected for measurement of individual hydrocarbons.

Because of the extremely wide range of densities and boiling points covered by the components of this mixture unusual care was required to maintain stream composition during conversion of the liquid phase stream to a vapor phase test sample.

Use of a portion of this stream as a reference sample was unsatisfactory because of stratification on storage and because of fractionation at low vaporization rates. A special mixture of two of the hydrocarbon components only was employed as a reference sample for the infrared analyzer.

The above sampling systems—No. 1 for one infrared analyzer operating on three process streams and No. 2 for an infrared, an ultraviolet and a

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B. W. Thomas is at present a research specialist at Humble Oil & Refining Co., Baytown, Texas. His major interest is in continuous analytical instruments for process streams. Thomas received his M.S. and Ph. D. in Physics from the Pennsylvania State College in 1934 and 1938, following which he joined Humble. In addition to work on various phases of superfractionation, gasoline blending and lube oil extraction techniques, he has been associated with analytical chemistry and spectroscopy since 1942. A member of the American Chemical Society and the Instrument Society of America, Thomas' chief off-the-job hobby is carpentry.

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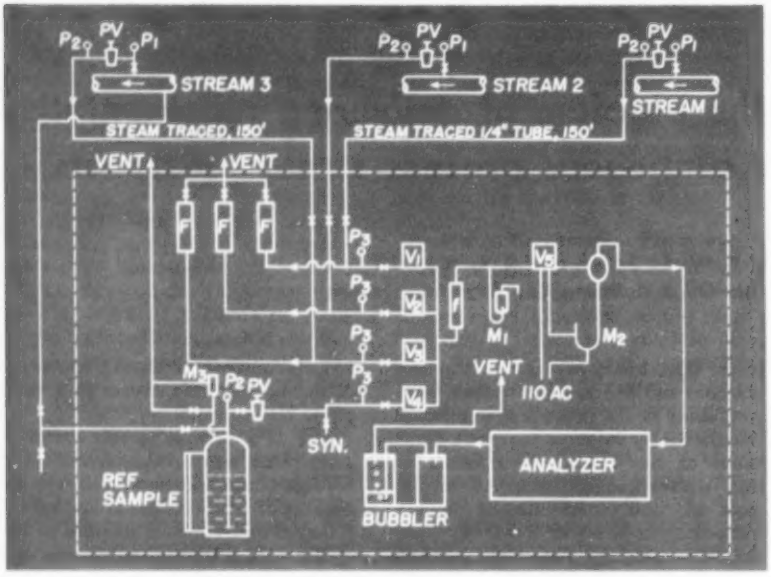


SYSTEM NO. 1—One analyzer on three streams

Legend for System 1

P_1—Liquid stream pressure, 150 psig.
P_2—Vapor sample pressure, 7 psig.
P'_2—Reference sample pressure, 10-15 psig.
P_3—Test sample pressure, <0.5 psig.
PV—Steam heated pressure reducer and vaporizer.
PR—Pressure reducer.
F—Flowrators on flushing line, 200 ml/min.
f—Flowrator on test sample, 10-15 ml/min.
M_1—Sample manometer, 3 mm. Hg.
M_2—Liquid safety: closes V_5, stops flow to analyzer.
M_3—Safety valve, 100 psig.
V_1, V_2, V_3, V_4—Normally closed solenoid valves, operated by 1-hr. cycle timer, open 15 min. each per hour.
V_5—Normally open solenoid valve; closed only by liquid entering mercury contact switch M_2.
Syn—Point for manual injection of synthetic mixture.
Analyzer—Nondispersion infrared gas analyzer.
Ref. sample—Laboratory analyzed liquid from Stream 3; propane cylinder equipped with sight glass and safety pip valve.
Dotted line—Indicates special analyzer room; not in main control house.

total hydrocarbon analyzer operating on one process stream—are shown graphically in the accompanying drawings. Legendary information is presented in the accompanying tables.

Pressure, Temperature and Flow Rate Must be Controlled

For the two sample systems described, vapor phase samples were analyzed continuously at atmospheric pressure. Samples were withdrawn from the liquid process streams at a pressure of 150 psig. Steam-heated, pressure-reducing valves were placed in close proximity to point of withdrawal in order to minimize liquid holdup. These steam-heated valves functioned as liquid sample vaporizers and as pressure reducing valves. In System No. 1 samples at the reduced pressure of 6-7 psig. were passed through 150 ft. of steam traced copper tubing to the analyzer room and continuously vented through flow rate indicators.

At a vapor sample flow rate of about 200 ml/min. in these lines a maximum of 5 minutes was required for fresh sample from the process to reach the analyzer. Portions of the flushing streams and a reference sample were caused to pass sequentially to an infrared analyzer by means of solenoid valves and a cycletimer.

In System No. 2 liquid sample was circulated 300 ft. from a process pump discharge to within a few feet of the analyzer room and returned to the pump suction. Liquid sample from the circulating stream at 150 psig. was passed through a steam-heated pressure reducer and vaporizer valve with a pressure reduction to 7 psig.

To maintain liquid phase composition in the vapor phase sample two additional pressure reducing valves were required in the streams to the three analyzers. Partially flattened copper tubing also aided in furnishing well-mixed, low-time-lag vapor phase sample to the instruments. Final flow control of test sample to the three analyzers was accomplished through use of individual stainless steel needle valves and low capacity flow rate indicators.

Temperature control of the samples through the infrared analyzers was accomplished by means of a coiled tube inside of the analyzer thermostated cases.

Vapor Pressure Differences May Cause Errors

Because of the relatively fast and continuous flushing rate of sample from the process streams, no particular difficulty was experienced with fractionation in the three-stream analyzer system. It was found satisfactory to employ one of these streams as the reference sample. The reference sample was analyzed in the laboratory prior to use for this purpose. A separate line of ¼-in. pipe was employed for filling the reference sample drum with liquid from the process stream. By maintaining the analyzer room temperature above 70° F. sufficient pressure was exerted by the stream components in System No. 1 to furnish reference sample to the analyzer. Reference sample was withdrawn from the liquid phase through a dip pipe to the bottom of a storage drum. After use of about 80% of each reference sample the remainder was discarded to avoid compositional changes resulting from vaporization within the drum.

Because of the wide density (0.6 to 0.9 gms/ml) and boiling point (—10 to +93° F.) range on the stream being handled by System No. 2, considerable difficulty was experienced in maintaining liquid phase composition in the vapor phase sample. This was especially true in attempting to employ a laboratory-analyzed stream sample as a reference for checking zero drift automatically on the infrared analyzer.

The five hydrocarbon components were considerably lighter in liquid phase density but higher in boiling points than the non-hydrocarbon component. As a result of the density differences an apparent separation into two phases occurred upon standing in the reference sample drum and material withdrawn from the lower half of the drum usually contained an erroneously high concentration of the high density non-hydrocarbon component.

Boiling point differences in the stream components also tended to cause an excessive concentration of the low-boiling non-hydrocarbon component in vapor samples withdrawn from the reference drum. Since these

effects were additive, use of the stream sample as a reference for the instruments in System No. 2 was impractical.

Analyzer Sensitivity and Zero Drift Require Systematic Checking

Instruments without drift in zero position and without fluctuations in sensitivity do not appear to have been achieved by instrument manufacturers to date. Correction and/or compensation for these variables in laboratory equipment may be overcome with comparative ease.

In plant installations, however, many factors beyond easy control have contributed toward amplification of errors caused by variations in analyzer sensitivity and zero positions. So serious are these errors in most cases that systematic means must be provided for their measurement and control in plant applications.

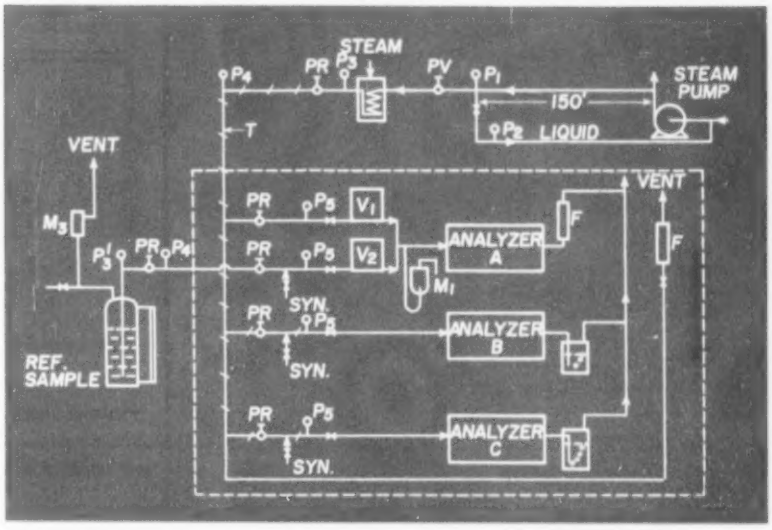
This is especially true for recorder response of plant instruments in which optical systems have been designed and sensitized for single component analysis in mixtures containing three or more components, all of which possess similar optical characteristics.

Testing for analyzer sensitivity or zero position can best be handled through use of synthetic mixtures, the composition of which stimulates that of the stream to be analyzed. An alternative procedure is to employ a laboratory-analyzed portion of the plant stream as a reference mixture. In either case, storage and periodic passage of the known sample automatically to an analyzer requires exacting control of composition, pressure, temperature, and flow rate. Two or more mixtures with variations in composition of the key component are needed for sensitivity checks but one known mixture is adequate for measurement of zero position or instrument response.

As indicated in the drawings, synthetic mixtures were injected manually for analyzer sensitivity checks. Frequency of sensitivity checks depends upon the requirements of each instrument and may vary from monthly to semiannually.

In System No. 1 a laboratory-analyzed plant sample is automatically injected once every hour for recorder zero checks. During passage of the reference sample, circuitry within the analyzer amplification system automatically corrects for drift.

In System No. 2 a special binary blend of the key component and one of the close boiling hydrocarbon components is passed through analyzer A once every 3 hrs. Switching between the test and reference streams is automatic but corrections for drift in this analyzer, as required, are achieved by manual adjustment. All test work on analyzers B and C of System 2 require manual introduction of known samples and manual correction for instrument drifts.



SYSTEM NO. 2—Three analyzers on one stream

Legend for System 2

P_1—Pump discharge on liquid stream, 150 psig.
P_2—Pump suction on liquid stream, 50 psig.
P_3—Vapor sample pressure, 7 psig.
P'_3—Reference sample pressure, 10-15 psig.
P_4—Vapor sample pressure, 2 psig.
P_5—Test sample pressure, <0.5 psig.
PF—Steam heated pressure reducer and vaporizer.
PR—Pressure reducer.
F—Flowrator on test sample, 10 ml/min.
M_1—Safety manometer, 3 mm. Hg.
M_2—Safety valve, 100 psig.
V_1, V_2—Normally closed solenoid valves, operated by 3-hr. cycle timer, V_2 open 15 min. every 3 hrs.
T—Partially flattened ¼ in. copper tube.
Syn—Point for manual injection of synthetic mixture.
A—Nondispersion infrared gas analyzer for Component A.
B—Ultraviolet spectrophotometer gas analyzer for Component B.
C—Total hydrocarbon, thermal conductivity analyzer for Components A + B + C + D + E.
Ref. sample—Synthetic mixture of A and D.
Dotted line—Indicates special analyzer room, adjacent to main control room.

Safety Is Byword

First requirements of plant analyzer sample handling systems are that the overall installation adhere strictly to safety precautions of the area in which the instruments are to operate. Both analyzer and sample system should be housed outside the process unit control room. Explosion-proofing of analyzer and all associated electrical circuits is highly recommended. Means should be provided to prevent excess pressure on analyzer sample cells. Vapors from test samples should be vented outside of the analyzer room. Reference sample drums should be equipped with pressure indicators and safety pop valves vented outside of analyzer room.

Referring to the drawings, M_1 represents a mercury safety manometer in which pressure in excess of 3 mm. of mercury is automatically vented to protect the analyzer sample cell from damage. A second safety feature was installed on the sample line of System No. 1 to prevent liquid entering the analyzer. This system consists of a mercury U-tube M_2 equipped with electrical contacts. As liquid enters tube M_2 it causes mercury around the bottom electrode to make contact with a second electrode and close solenoid valve V_3. Thus, liquid in the test sample will close the normally-open solenoid valve and prevent flow of liquid into the gas analyzer.

Acknowledgment

The preceding article comprises the paper "Sampling Systems for Continuous Plant Analyzers," prepared by B. W. Thomas and R. L. Martin, Humble Oil & Refining Co., Baytown, Texas, for presentation at the 8th National Instrument Conference of the Instrument Society of America, Chicago, Sept. 21-25, 1953.

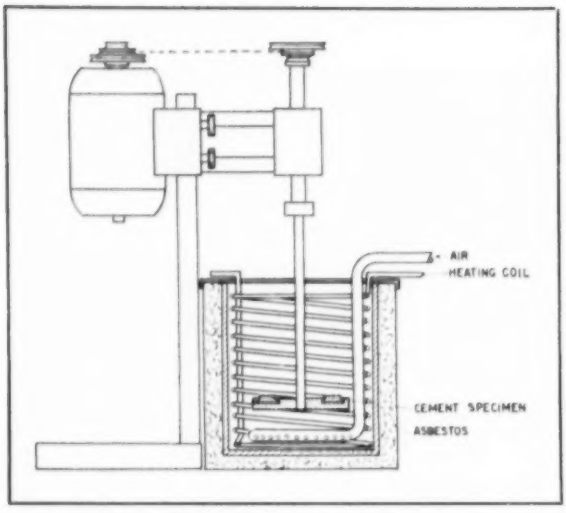


FIG. 1—Dense phase rotary erosion test

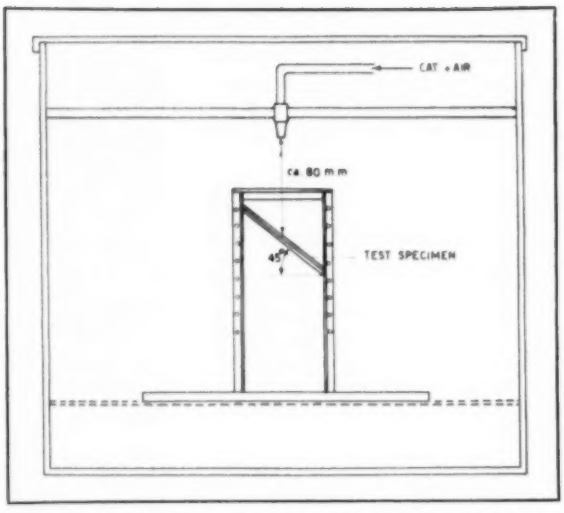


FIG. 2—Test in dilute phase (catalytic blasting) at 20° C

HOW TO

Test Cement for Erosion Resistance

This article deals with work carried out at the Koninklijke / Shell - Laboratorium, on the testing of erosion-resistant cements as lining materials for catalytic cracking units. Among the factors governing the choice of material, in addition to erosion resistance, are dimensional stability during drying and firing, blistering tendency, ease of application and possibility of repair. Various test methods are described and the most suitable recommended for use.

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CEMENT liners are used to combat erosion and insulate equipment walls in many types of catalytic cracking units. Regenerators are usually provided with a layer of insulating cement, covered by a layer of erosion-resistant cement. Spent-catalyst risers and regenerator cyclones are covered only with the latter type material, while reactor parts, generally, are not lined at all.

Choice of cement, though largely governed by its resistance to erosion, is also dependent on such factors as ease of application, dimensional changes during drying, adherence to steel reinforcement and possibility of repair. At spots of severe wear on the lining, a high-erosion resistance obviously comes first, and if necessary the other requirements will be moderated. Elsewhere, easy applicability for instance, may be considered more important than high erosion resistance.

In developing the test methods outlined below, these three factors have been considered:

1—Resistance to erosion.
2—Ease of application and behavior in drying and firing.
3—Mechanical properties and the influence of reinforcement.

Determination of Erosion Resistance

Three types of erosive action in catalytic cracking units were analyzed:

1—*Erosion from catalyst movement in a fluid bed.* In this case, the angle at which catalyst particles impinge on the wall is small. This type wear was estimated in a dense-phase rotary erosion test in which fluid bed regenerator conditions were approached.

2—*Erosion from a dilute-phase catalyst stream having a large impingement angle.* Because of thermowells in lines and roughness of the cement surface, a dilute-phase catalyst stream can impinge on the lining of risers and cyclones at a considerable angle. Tests imitating these conditions were developed in which specimens were exposed to a catalyst at room temperature and at 600° C.

3—*Erosion from a dilute-phase catalyst stream with a relatively low impingement angle.* Stream conditions in cyclones, in particular, should be such that the impingement angle is low. Conditions occurring in regenerator cyclones were imitated in a test carried out in a special rig.

Dense-phase rotary erosion test. This test, intended to imitate conditions prevailing in the regenerator bed, was carried out in the apparatus illustrated in Fig. 1.

Cement to be tested was placed in the annular groove of a stainless-steel disc rotating at the rate of 1600 to 1700 rpm. in a fluidized bed, the temperature being maintained at 600° C. by a heating coil. The fluid bed was agitated by action of the disc, and a

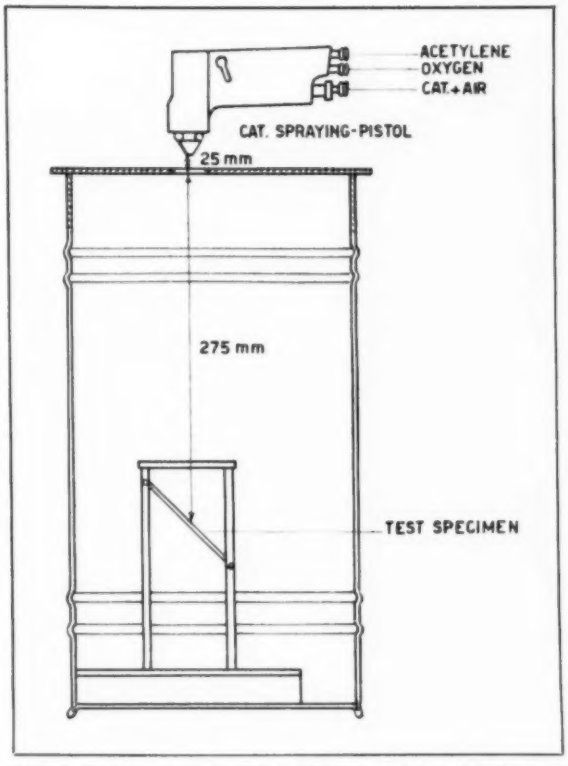

FIG. 3—Erosion test in dilute phase (catalytic blasting) at 600° C

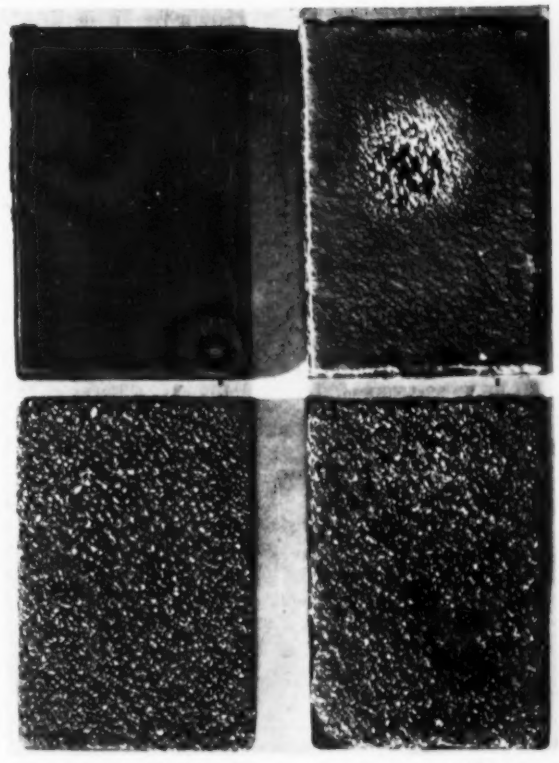

FIG. 4—Test specimens after exposure to catalytic blasting at 600° C

vortex formed. Amount of wear was characterized by loss in weight of the test specimen.

It was found that, although in this test speed of the catalyst relative to the cement is much higher than in actual practice, loss in weight of the specimens was very low.

"Catalytic-blasting" at 20° C. A severe test for imitating erosion in a dilute phase with a catalyst stream impinging on a wall at a large angle was performed by filling a laboratory-type of sand-blasting apparatus with spent catalyst (Fig. 2).

The blast was directed at specimens consisting of a thin steel plate to which a layer of cement 5.5 mm. thick had been applied by trowelling. Some of these were allowed to set at room temperature for about 20 hr. and then heated to 110° C., at the rate of 10° C./hr. Others were, after this treatment, fired by heating to 600° C. at the rate of 60° C./hr., maintained at this temperature for at least 1 hr. and then slowly cooled.

Experiments with reinforced cement were soon discontinued, because drying and firing developed cracks, which in most cases widened rapidly during the test.

To obtain reproducible results, the specimens at an angle of 45° were placed on a mounting 80 mm. from the blasting nozzle, and the time required to penetrate the cement layer was measured. Particle speed in this test was about 65 m./sec. The catalyst impinged on an area of about 6 cm.^{2} of the test specimen at the rate of 50 kg./hour.

In view of the wide differences in results obtained for fired and non-fired specimens, it is essential they should be given exactly the same pre-treatment as the cement used in actual practice. The erosive agent should also be the same.

Penetration times of twelve different cements varied from 15 to 400 sec. Reproducibility was on the whole satisfactory.

"Catalytic-blasting" at 600° C. In this test the sand-blasting apparatus was replaced by a metal-spraying pistol (Fig. 3). Instead of metal powder, catalyst was fed into the pistol.

The specimen was pre-heated to 600° C. in an electrical furnace and transferred to the testing apparatus without cooling. To keep the surface temperature of the specimen at 600° C. it had to be placed at a distance of 30 cm. from the pistol. The surface temperature was measured by means of Seger cones and thermocouples.

As in the preceding test, time necessary for the catalyst to penetrate a cement layer of 5.5 mm. was measured. Capacity of the powder tank of the pistol limited the exposure time to 30 min. If the layer had not been penetrated within this time, penetration time was calculated from the depth of the pit by extrapolation. Some exposed test specimens are shown in Fig. 4.

Particle speed could not be determined with any accuracy. The amount of catalyst impinging on the specimen was about 9 kg./hr.

This test appeared to be less severe than the preceding one: Penetration times varied from about 350 to 9000 sec. (extrapolated).

Erosion testing in a test rig. As an attempt to imitate the conditions prevailing in an actual plant, a special test rig was built (Fig. 5 and 6). It consisted of a propane-air burner, developed by Koninklijke/Shell-Laboratorium, Delft, delivering a stream of hot flue gas, into which a continuous stream of catalyst was injected. This stream passed through a riser and entered a cyclone with a test specimen and an observation window (Fig. 7). The catalyst dropped into a hopper, where it was fluidized and recycled.

Cements to be tested were exposed in the cyclone, mounted in a stainless-steel specimen-holder (Fig. 8). The mounting was placed in line with the axis of the inlet port and flush with the wall of the cyclone. The loss in weight of the specimen was measured

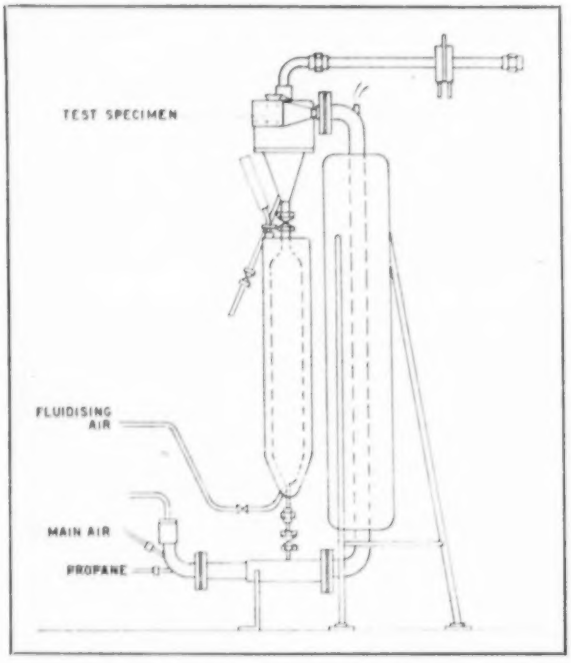

FIG. 5—Schematic diagram of erosion test rig

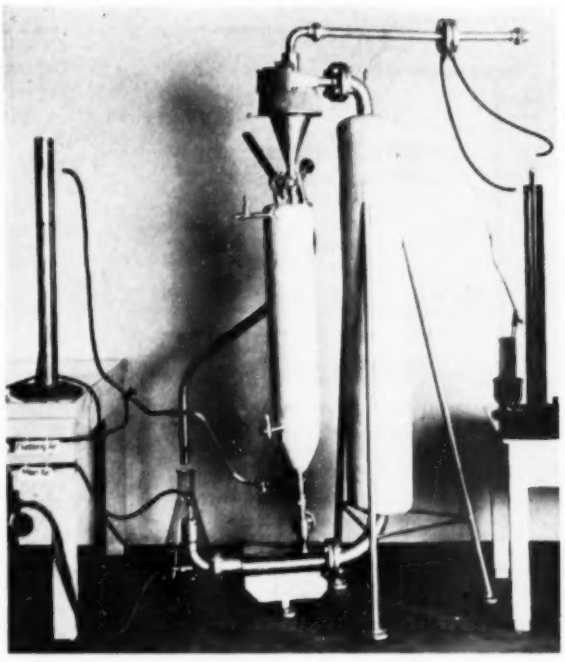

FIG. 6—Photograph of same laboratory apparatus ready for use

after 6 hr. exposure under standard test conditions.

Conditions in the erosion test rig were:

Initial gas velocity in the cyclone	about 5 m./sec.
Load	about 1 kg./m.^{3}
Amount of catalyst entering the cyclone	7-8 kg./hr.

In the test's initial stage, erosion is caused by particles with a low impingement angle. Subsequently, impingement angles will increase owing to surface roughness (e.g. aggregate) and the figures will show a trend in line with the results of the foregoing test, where large impingement angles were employed.

When tested by this procedure the cements could be distinguished into two broad groups: the first where the test plate lost more than 10 g. per run, and the second where it lost less than 1 g. per run. The data of the second group lay so close together that it was almost impossible to draw conclusions by comparison.

In some experiments influence of the surface condition of the cement was investigated. From two test plates, coated with different cements, the surface layer was removed by sand blasting before testing in the rig. Results showed that the erosion resistance of the one cement had decreased, while that of the other was still the same.

Behavior of Cement in Drying, Firing

Since all cements contain water as they are applied, certain dimensional changes develop during drying.

When ready for use most cements

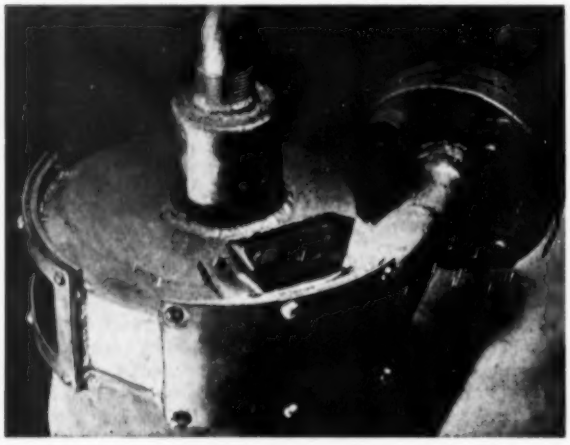

FIG. 7—Test specimen in rig. Note specimen, illumination window (center), observation window (left)

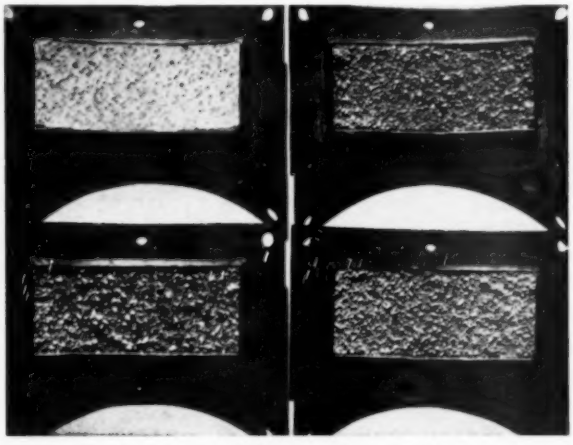

FIG. 8—Variety of results obtained after samples are exposed in test rig

can be worked for a limited time only, because of setting. The length of this period differs and is usually given in the instructions for use received from suppliers. There are, however, some "premixed type" cements which do not show this phenomenon, but become hard owing to evaporation of the water to the air. At room temperature this takes a long time, especially when a thin hard skin is formed which prevents the water in the soft layer underneath from evaporating easily.

Generally, drying can be speeded by increasing the temperature, but in some cases this may lead to blistering even when only a temperature increase of 10° C./hr., with sufficient air circulation, is applied. A suggestion that the blistering effect might be prevented or at least reduced by making nail holes in the cement layer after application, but before drying, proved to be of no practical value. To determine the tendency toward blistering, the following test was carried out.

Test cubes of 2-in. dimensions were made and dried at room temperature for about 16 hr. Then the cubes were dried for 1 hr. at 100° C. and subsequently heated to 600° C., which takes about 2½ hr. The degree of blistering can usually be judged from the deformation of the cubes.

To obtain an impression of the deformation of the cements during drying and firing, conditions met in practice were imitated as far as the erosion-resistant lining is concerned.

A layer of 20 mm. insulating cement was applied to a steel plate, bearing studs to hold a reinforcement of Acme floor steel (thickness ⅝-in.) suspended at a distance of ⅜ in. from the top of the insulating layer. Cements to be tested were trowelled in, forming a layer of 1 in. thickness, flush with the reinforcement.

After drying and firing, the formation of shrinkage cracks and blisters was studied by visual examination.

Most of the cements tested showed shrinkage and had become detached from the steel. Some also showed shrinkage cracks. Removal of the upper layer by sand blasting revealed that part of the cracks were only of a superficial nature.

Mechanical Properties of Cement

The mechanical properties of the lining material are important for several reasons. In the first place cement must be sufficiently strong because the adhesion to the steel has been found to be almost nil. The lining must therefore be kept in place chiefly by its anchorage with the steel reinforcement. Moreover, it must be capable of withstanding a certain amount of thermal and mechanical shock. Finally, the bond between insulating and erosion-resistant material and between an old and a new layer of the latter is important.

To gain an impression of the abovementioned properties of cements the following tests have been made:

1—Tensile tests.

2—Tensile tests with "repaired" tensile test pieces.

3—Tensile tests to determine the adhesion to steel.

4—Tensile tests to determine the adhesion of erosion-resistant cement to insulating cement.

5—Impact tests.

Tensile tests. The tensile strength of the cement was determined with a tensile test bar according to the Dutch Standard Specification for cement N 495. Tests were carried out after drying at room temperature and after drying and firing according to our standard procedure outlined above.

The results are given in the accompanying table.

Tensile tests with repaired specimens. To estimate the strength of the bond in a repaired lining, test specimens were prepared as follows:

One half of a test specimen pulled to fracture was placed in the standard mould for these specimens, then thoroughly wetted, made up to a complete one with fresh cement mix and dried or dried and fired. Then the tensile strength of the new bar was determined.

The results of the tensile tests with repaired cement test bars, viz. the "dried — broken — repaired — dried" bars, and the "dried—fired—broken—repaired—dried—fired" bars are also given in the accompanying table.

Tensile tests to determine adhesion to steel. The adhesion of cement to steel was measured with tensile test bars, with a small sand-blasted steel plate inserted in the narrowest part. The test bars were dried and tested in a tensile testing machine.

The strength of most test specimens with steel inserts after drying was so poor that no tensile tests could be performed. They quite often broke under their own weight. Only a few cements had a measurable adhesion (about 8 kg./cm.²) to steel.

No tensile tests could be performed after drying and firing, because by firing the adhesion is reduced to zero, due to oxidation of the steel surface.

Tensile tests to determine the adhesion of erosion-resistant cement to insulating cement. The adhesion of the erosion-resistant material to the insulating material was measured by the same technique as described for the repaired specimens. Broken test bars of insulating cement were "repaired" with erosion-resistant cement, dried or dried and fired, and tested for tensile strength.

It appeared that in this test the halves of most of the repaired bars became detached during drying or firing. Only one cement showed favorable results.

Impact tests. The erosion-resistant cements were subjected to impact tests to determine their reistance to mechanical shock.

Two types of tests were performed on the materials in the dried and fired condition:

1—The first consisted in dropping a steel ball from a height of 2 m., striking the test specimens with an energy of 1.5 kgm. The specimens consisted of a 1-in. layer of the various erosion-resistant cements in a reinforcement of Acme floor steel, backed by a 20-mm.-thick layer of insulating cement and a 3-mm. steel plate. These test specimens were the same as described above. Owing to the impact, two types of destruction of the cement layer could be distinguished: either the

Tensile Strength of Cements in kg/cm²

Cement	Dried (20°C)	"Dried-Fired"	"Dried-broken-repaired-dried"	"Dried-fired-broken-repaired-dried-fired"
A	20.0	13.7	< 5.5	< 5.5
B	69.4	39.9	32.8	13.2
C	28.8	17.1	—	< 5.5
D	21.0	16.6	15.3	10.9
E	32.2	—	< 5.5	—
F	26.1	13.9	< 5.5	—
G	20.1	7.1	< 8.3	—
H	39.6	24.7	17.9	16.8
J	21.0	19.5	< 5.5	< 5.5
K	—	23.5	—	15.4
L	—	14.5	< 5.5	< 5.5
M	6.4	6.5	—	—

layer cracked almost throughout its whole thickness, or the destruction was limited to superficial damage. If one impact was not sufficient to obtain either cracking or damaged to a depth of about 2 mm., the test was repeated. Since it is preferable to have a shock-resistant cement, superficial damage is considered better than cracking.

2—The second test consisted in dropping steel balls of increasing size from a height of 1 m. on blocks of the erosion-resistant cements. The blocks used were the halves of broken tensile test specimens. The minimum energy of the impact, in kgm., necessary to destroy the test block, was reported. The higher this figure, the more shock-resistant the cement is.

Placing of Steel Reinforcement

In risers and cyclones the lining consists of erosion-resistant material only, about 1 in. thick. Since the bond between the lining and the wall consists in the anchorage provided by the steel, it seemed better to place the reinforcement at some distance from the wall. To confirm this, test plates were used consisting of ¾-in. steel plates, size 50 x 50 cm., having the Acme-floor steel welded direct on the surface and at a distance of ⅜ in. by means of spacers (⅜-in. square rods). The lining material was filled in flush with the steel matting. The test plates were subjected to repeated heavy impacts on the side of the steel plate.

It was shown very clearly that mounting of the reinforcement at a distance is better. A number of small cement blocks filling every square of the Acme-floor steel became detached from the test plate with the steel reinforcement against the wall, while only one piece became detached from the test plate with the matting on spacers. Moreover, where this piece came off, the steel wall was still covered with a cement layer about ½ in. thick.

Additional Data

As erosion tests are generally rather difficult to reproduce, it is not surprising that there is some spread in the results.

Comparison of the results of different erosion testing procedures is hardly possible, because the erosive action is different in each case.

It is not reasonable to expect corresponding results in the "catalytic blasting" tests carried out at room temperature and at 600° C., not only because of the differences in temperature and mechanical properties, but also because of the different speeds of the catalyst particles in the two testing procedures. These two methods have one important point in common, the impingement angle (45°).

There seem to exist two totally different types of erosion by impingement of solid particles, the first being a sort of scouring action by particles having a low impingement angle, e.g. <5°, and the second being caused by particles having a higher impingement angle.

The tests in this investigation covered both types of erosion. The densebed rotary erosion test was definitely of the type of low impingement angle. In the test rig the impingement angle was low in the initial periods, due to the position of the test specimens in the cyclone; when, however, the surface was roughened by erosion, e.g. when the aggregate particles were sticking out, the impingement angle increased and the test conditions became more like those prevailing in tests with a high impingement angle. The "catalytic blasting" tests were of the high impingement angle type.

The apparent contradiction in some results of the various erosion tests is therefore not real, but indicates a difference in erosion resistance of the materials under different conditions.

Since this investigation has shown that even with different batches of the same type of catalyst widely different results can be obtained, it is clear that comparative tests should be carried out with a standard grade of "erosive" material.

It should be emphasized that service tests must ultimately prove a correlation with laboratory experiments. It was, for instance, impossible to determine how the cement would behave on prolonged heating. Neither could the effect of the method of application (guniting versus trowelling) be established.

In view of the results obtained, the following testing procedure may be recommended for the time being:

1—Determination of the erosion resistance by "cat. blasting" at room temperature of test plates fired to the temperature of the catalyst in regenerator and catalyst lines, with a thickness of 5.5 mm., in comparison with a standard material.

2—Determination of the tensile strength of fired test specimens.

3—Determination of the impact value of cement blocks without reinforcement (broken tensile test specimens).

4—Determination of the tendency to blistering with 2-in. cubes.

Acknowledgement

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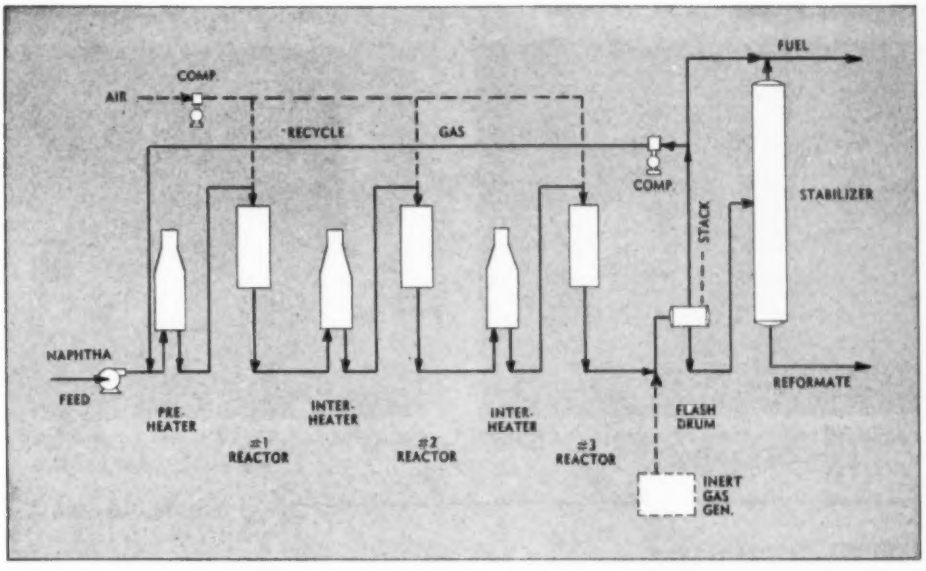

MORE FLEXIBILITY is one claim made for Sinclair's new catalytic reforming process, which includes optional provisions (dotted line) for regeneration

Sinclair's 'Cat' Reforming Process

Uses 'RD-150' catalyst, with high paraffin cyclization activity, regeneration features

By J. W. TETER, B. T. BORGERSON and L. H. BECKBERGER

Sinclair Research Laboratories, Harvey, Ill.

EVER increasing demands for higher octane motor gasoline and aromatic hydrocarbons for chemicals have emphasized the need for the development of highly efficient yet flexible catalytic reforming processes. Sinclair Research Laboratories, Inc., and Baker and Company, Inc., have developed a new platinum reforming catalyst, *RD-150*, which possesses two major advantages (1) a high ratio of paraffin cyclization activity to hydrocracking activity, and (2) an ability to be regenerated with diluted air.

The improved paraffin cyclization activity makes possible the efficient conversion of paraffins to aromatics. Therefore a superior yield-octane relationship at high octane levels and a greater aromatics yield are achieved. In addition, this characteristic makes possible a superior yield-octane relationship for paraffinic naphthas which extends the usefulness of this catalyst to a wide variety of feedstocks.

The ability of the catalyst to be regenerated provides the refiner with a means of extending the life at operating conditions more favorable from an equilibrium standpoint for producing a superior yield-octane and improving the aromatics yield.

In general, these two major advantages provide the refiner with a catalyst whose performance gives a wide choice of plant designs to meet present and future markets for high octane gasoline and aromatics with greatly improved catalyst selectivity and life.

Sinclair Refining Co. has announced the incorporation of this new catalyst in the design and construction of a 16,000 b/d catalytic reformer at its Marcus Hook, Pa., refinery (1, 2) C. F. Braun & Co. is contractor for this unit, which is scheduled for initial operation in the summer of 1954.

Catalytic reforming is superior to thermal reforming because of the catalyst's ability to isomerize and dehydrogenate naphthenes to aromatics and isomerize straight chain paraffins to higher octane isomers with a mini-

Table 1—Feed Stock Characteristics

	Crude Source			
	Mid-Continent	Venezuela	Kuwait	Pennsylvania
Gravity, °API	54.1	48.6	54.0	57.4
IBP °F.	236	252	240	214
10%, °F.	257	273	283	232
50%, °F.	291	306	310	260
90%, °F.	341	358	337	308
EP, °F.	373	385	355	336
Naphthenes, %	43.2	43.0	19.4	27.7
Aromatics, %	7.7	22.9	14.7	11.1
Paraffins, %	48.8	33.8	65.1	58.8
Sulfur, wt. %	0.021	0.032	0.087	0.072
Octanes, Research:				
Clear	36.5	51.0	29.6	43.4
+3.0 cc TEL	61.0	73.0	52.5	65.5

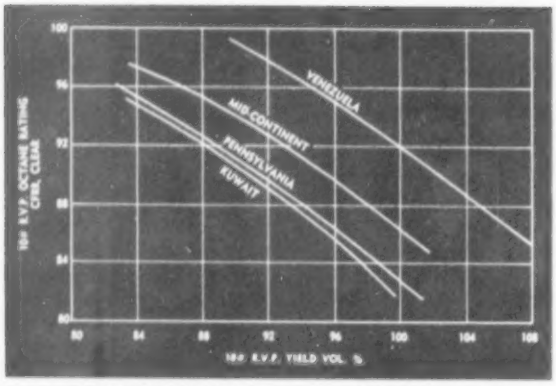

FIG. 1—10 lb. RVP. yield-clear octane relationships, continuous processing at 500 psig.

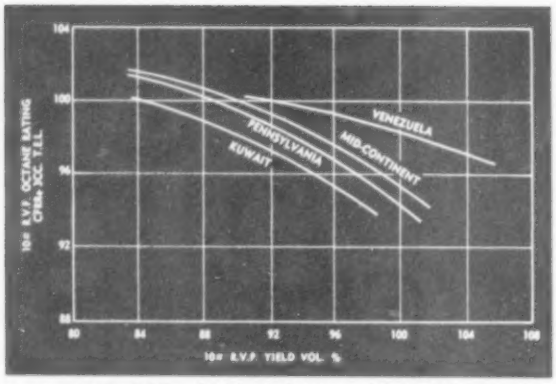

FIG. 2—10 lb. RVP. yield-leaded octane relationships, continuous processing at 200 psig.

Table 2—Continuous Operation at 500 psi.

	Crude Source							
	Mid-Continent		Venezuela		Kuwait		Pennsylvania	
Reformate Yields:								
C_5+, vol. %	86.8	79.0	91.7	85.8	85.6	75.6	85.0	74.8
10# RVP, vol. %	99.8	89.4	107.3	97.5	96.4	84.4	97.2	84.4
Octanes, Research:								
C_5+, clear	85.0	95.0	85.0	95.0	85.0	95.0	85.0	95.0
C_5+ 3 cc. TEL	94.6	99.6	95.5	99.5	94.2	99.7	96.0	99.7
10# RVP, clear	86.0	94.6	86.0	94.6	85.8	94.3	85.8	94.7
10# RVP + 3 cc. TEL	95.3	99.8	97.2	99.7	95.1	99.9	96.5	99.9
Butanes, vol. %								
Produced	4.4	6.4	2.0	4.2	4.9	8.5	5.5	8.9
Outside, to 10# RVP	8.6	4.0	13.6	9.5	5.9	0.3	6.7	0.7
Light Gases:								
C_1, wt. %	1.0	1.5	0.5	1.2	1.3	2.2	1.2	1.9
C_2, wt. %	2.4	3.0	0.8	1.9	2.4	4.5	1.9	3.0
C_3, wt. %	4.5	6.5	1.2	3.1	3.5	7.2	3.7	6.7
Hydrogen, CF/Bbl.	550	740	725	683	510	470	685	590
Reformate, C_5+:								
Gravity, °API	48.0	46.7	43.1	42.1	48.9	45.5	47.4	46.6
IBP °F.	141	138	158	148	—	—	138	134
10%, °F.	220	210	246	227	—	—	208	191
50%, °F.	286	281	298	291	—	—	261	256
90%, °F.	340	352	362	363	—	—	323	328
EP, °F.	414	420	432	440	—	—	378	387
Sulfur, wt. %	.004	.004	.009	.005	.006	.006	.005	.005

mum production of light gases and high molecular weight compounds. Not only does the Sinclair-Baker catalyst *RD-150* achieve these desired results, but in addition it has the ability to obtain significant conversion of paraffins to aromatics by dehydrocyclization. This advantage allows the production of high octane reformates from low naphthene content naphthas without the undesirable conversion of paraffins to light gases.

Because this new catalyst has a high initial activity which declines slowly during continuous processing, its use is attractive and competitive with existing continuous catalytic reforming processes. In addition, the catalyst can be restored to near initial activity by a simple regeneration in place with diluted air. This feature of the catalyst allows considerable flexibility in choice of operating conditions and therefore plant design to attain a more economical catalytic reforming process.

Because of the catalyst's resistance to sulfur and metal poisoning, pretreating of the feedstock is unnecessary up to moderate sulfur levels. For high sulfur stocks naphtha desulfurization or removal of hydrogen sulfide from the recycle gas may be required.

Description of Processing

A simplified flow diagram of the catalytic reforming process is shown above. During processing the naphtha fresh feed is combined with recycle gas and fed to the preheater. Preheated vapors pass in series flow through three or more fixed-bed reactors designed to minimize thermal effects. The vapors pass down-flow in these adiabatic reactors. Because of the overall endothermic nature of the reforming reactions, inter-heaters are provided between reactors to maintain process temperatures.

The effluent from the last reactor is cooled by exchange to near atmospheric temperature before entering the flash drum. The hydrogen-rich gas leaving the flash drum is split in two streams. The net flash gas is released to a fuel line or sent to an absorber for recovery of light hydrocarbons. The remainder of the hydrogen-rich gas is compressed and recycled with fresh naphtha feed. The liquid leaving the flash drum is taken to a stabilizer for separation of light hydrocarbons from the finished reformate.

Processing conditions are fixed by consideration of the quality and yield of desired products consistent with economic operating costs, capital expenditure, and available feedstocks. In general the preferred range of operating conditions are 200-750 psig., 825-950° F., and based on fresh feed, a 1 to 5 weight hourly space velocity and 3 to 10 molal recycle gas ratio.

The dotted lines in the flow diagram show one proposed method for catalyst regeneration. With continuous processing, it may be desirable to regenerate the catalyst once every three to six months to achieve maximum productivity. Regeneration is started by depressuring and purging the system with inert gas from a small generator. After purging, the system is filled with inert gas to a low pressure, the gas generator is stopped and the recycle compressor is placed in operation. When regeneration temperatures are reached a controlled amount

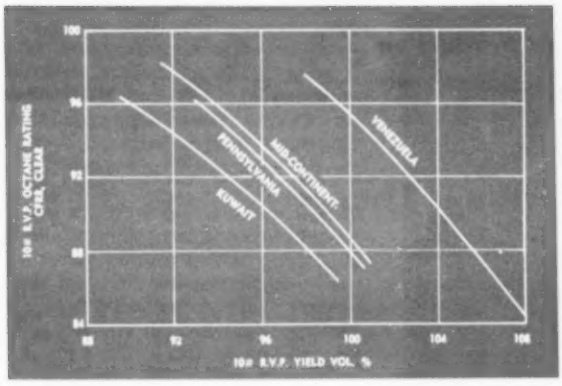

FIG. 3—10 lb. RVP. yield-clear octane relationships, continuous processing at 200 psig.

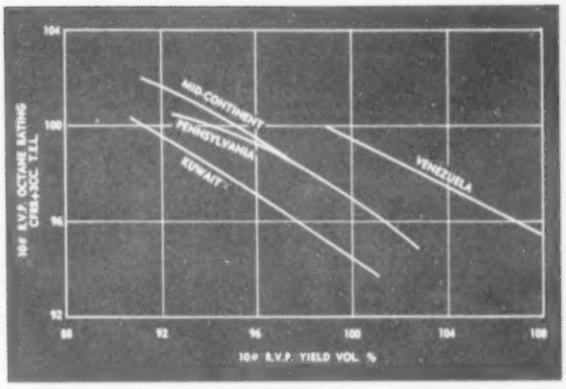

FIG. 4—10 lb. RVP. yield-leaded octane relationships, continuous processing at 500 psig.

of air is supplied to each reactor to complete combustion of the carbonaceous material which had fouled the catalyst. After regeneration the unit is depressured, purged and either hydrogen or process recycle gas circulation is established at somewhat lower than the usual operating pressure. Normal operating pressures are restored by resumption of naphtha processing at mild conditions.

The length of the naphtha processing cycle is dependent upon a number of variables. Low operating pressure, low naphthene content feedstock, high space velocities, low recycle gas ratios, the production of high octane reformates and increased number of regenerations tend to decrease the length of the naphtha processing cycle. With paraffinic naphtha and the requirement of above 90 research clear octane reformate or high aromatic production it may be desirable to design a unit for the regenerative type operation.

Low pressure operation offers the advantage of improved yields when considering the regenerative type of operation. Design for this operation is essentially the same as that for the continuous process described above. The basic change involves provisions for regenerating a single reactor without interrupting the processing cycle on the remaining reactors. The choice of design is dependent upon an economic consideration of the balance between capital costs and increased earnings as affected by each design.

It may be desirable in the original design of the unit to provide facilities in addition to those mentioned above. A fractionation tower, integrated with the unit, for most economic feedstock fractionation, is such an item. Existing facilities may in many cases be adequate. When processing high sulfur naphthas, such as some West Texas or Middle East sources, it may prove economical to remove H_2S from the recycle gas with an absorbent system.

Table 3—Regenerative Operation at 200 psi.

	Crude Source							
	Mid-Continent		Venezuela		Kuwait		Pennsylvania	
Reformate Yields:								
C_5+, vol. %	87.8	83.3	91.8	86.8	86.8	81.2	87.8	82.2
10# RVP, vol. %	102.0	94.8	107.5	100.7	100.0	92.8	101.5	94.3
Octanes, Research:								
C_5+, clear	85.0	95.0	85.0	95.0	85.0	95.0	85.0	95.0
C_5+ 3 cc. TEL	94.4	99.7	95.2	99.0	93.5	99.2	95.6	99.2
10# RVP, clear	85.8	94.6	86.1	94.6	85.9	94.7	86.0	94.6
10# RVP+ 3 cc. TEL	95.3	99.9	96.2	99.4	94.5	99.4	96.4	99.4
Butanes, Vol. %								
Produced	2.8	4.2	1.5	2.9	3.2	4.9	2.2	4.9
Outside, to 10# RVP	9.8	7.9	14.2	11.0	10.0	6.7	11.5	7.2
Light Gases:								
C_1, wt. %	0.7	0.9	0.5	0.8	0.4	1.1	0.6	1.0
C_2, wt. %	1.8	2.1	0.6	1.3	1.3	2.4	1.1	2.1
C_3, wt. %	2.6	3.6	0.8	2.0	2.1	3.4	1.9	3.6
Hydrogen, CF/Bbl.	880	1150	930	830	730	875	910	1150
Reformate, C_5+:								
Gravity, °API	44.9	42.3	41.9	39.6	50.9	—	45.2	43.7
IBP °F.	130	126	190	150	—	—	—	139
10%, °F	209	207	252	242	177	—	—	200
50%, °F.	285	288	303	298	270	—	—	258
90%, °F.	360	363	370	378	362	—	—	343
EP, °F.	448	457	437	455	419	—	—	390
Sulfur, wt. %	.005	.005	.005	.005	.004	.004	.006	.007

Design Flexibility

To illustrate the possible flexibility in design, two alternates are considered. When processing a naphtha for the production of 80 to 90 research clear octane at operating pressures ranging from 200 to 750 psi., continuous catalytic reforming, such as practiced in the industry today, may be employed. This design may include simple facilities to regenerate the catalyst at the conclusion of each long processing period. In addition to improved yields, with paraffinic as well as naphthenic feedstocks, long periods of time between catalyst changes make this processing scheme attractive to the refiner.

When operating to produce reformate with research clear octanes above 90 it may be desirable to employ a regenerative type operation. This choice depends to some extent upon the paraffin content of the feedstock. The regenerative design permits processing at operating conditions consistent with optimum reformate yields at minimum operating and fixed costs. As distinguished from continuous operation, the regenerative scheme of processing embodies facilities to regenerate a portion of the catalyst without interrupting the processing cycle.

Motor Gasoline Production

The characteristics of a variety of feedstocks with which *RD-150* catalyst has demonstrated superior performance are shown in Table 1. Figs.

Table 4—Aromatics Production

Feed Stock Characteristics	Crude Source: Venezuela			California			Mid-Continent
Fractions	C_6	C_7	C_8	C_6	C_7	C_8	C_6
Gravity, °API	70.4	57.2	50.2	55.7	59.1	55.4	58.1
IBP °F.	148	190	248	161	192	245	162
10%, °F.	157	204	254	163	194	248	165
50%, °F.	164	214	263	165	198	251	166
90%, °F.	185	227	275	169	207	256	170
EP, °F.	248	265	295	195	215	266	180
Naphthenes:							
MCP vol. %	—	—	—	56.0	—	—	32.4
CH vol. %	—	—	—	28.2	—	—	37.9
DMCP vol. %	—	—	—	3.6	—	—	0.4
Total vol. %	20.1	32.4	31.4	87.8	62.5	59.0	70.7
Aromatics, vol. %	8.4	18.9	21.5	2.6	3.7	4.8	3.6
Paraffins, vol. %	71.5	48.7	47.1	9.6	33.8	36.2	25.7
Yields on Feed:							
Benzene, vol. % feed	13.7	1.5	0.5	57.0	0.8	0.3	50.0
Toluene, vol. % feed	8.2	28.2	4.0	2.7	46.2	1.7	1.6
Xylenes, vol. % feed	—	15.2	33.4	—	8.6	50.4	—
C_9+ Aromatics, vol. % feed	—	2.4	18.3	—	1.0	7.6	—
% Paraffin Cyclization [1]	—	10	24	—	25	19	—
C_5 vol. %	10.3	8.2	7.6	5.4	8.4	4.9	12.2
$C_1 + C_2 + C_3$, wt. %	8.6	5.2	5.7	4.2	5.8	2.2	13.1
Hydrogen, CF/bbl. feed	410	1000	1360	2110	2000	1350	1500

[1]Minimum cyclization, since it assumes that the naphthenes are converted to aromatics only.

Table 5—C_7 Cut Naphthene Isomerization

Conditions: 900° F., 300 Psig.

Feedstock Analysis Vol. %		Product Analysis Vol. % Fresh Feed		Naphthene Composition %	
Paraffins	37.0	31.2	Cyclohexane		2.3
Olefins	0.0	0.8	1,1-dimethylcyclopentane		12.9
Naphthenes	63.0	7.3	1,2-dimethylcyclopentane		45.0
Aromatics	0.0	44.4	1,3-dimethylcyclopentane		39.8

Table 6—Breakdown of Typical Operating Costs

	¢/Bbl.
Operating Labor	1.5
Supervision	0.1
Repair Labor	5.3
Repair Material	3.5
Payroll Burden	1.4
Operating Supplies—misc.	0.3
Utilities—Steam	5.1
—Power	0.6
—Water	1.3
—Fuel	1.8
Total Direct Operating Cost (excl. of catalyst)	20.9

1 and 2 show the high yields of finished 10 lb. RVP gasoline obtainable with 500 psig. continuous operation on both clear and leaded with 3 cc. of TEL bases. Similar yield-octane curves for 200 psig. regenerative processing are shown in Figs. 3 and 4. Typical product distributions for the 500 psig. continuous operation at 85 and 95 research clear octane are shown in Table 2. A similar tabulation of product yields for the 200 psig. regenerative operation is shown in Table 3.

For a given feed, an improvement in 10 lb. RVP yield is obtained with the 200 psig. as compared to 500 psig. operation for the range of 85 to 95 research clear octanes which are shown in Figs. 1-4. The improvement in yield obtainable by operation at lower pressure increases with increase in paraffin content of feed and with increase in reformate octane. Because the Sinclair-Baker catalyst may be regenerated, this improved yield can be acquired—thus illustrating the primary advantage to be gained by using the regenerability feature of the catalyst.

Production of Aromatics

The excellent yield-octane pattern for a wide variety of feeds, as shown in the previous section, is due, to a large extent, to the ability of the catalyst to efficiently produce large quantities of aromatics from both naphthenes and paraffins. The ability of the *RD-150* catalyst to convert paraffins to aromatics is illustrated in Fig. 5. Normal heptane was converted to aromatics at moderate space velocities to the extent of greater than 40 mole %, producing a 95 research clear octane reformate. Similarly, with normal octane at lower pressures 66 mole % conversion to aromatics was attained with a yield of 64 vol. % pentane and heavier reformate of greater than 100 research clear octane. Table 4 shows the benefits to be derived from the catalyst because of its remarkable paraffin cyclization activity when producing aromatics from C_6, C_7 and C_8 boiling range fractions. Also, typical feedstock characteristics and aromatic yields are given for these fractions which were prepared from a Venezuela, a California and a Mid-Continent crude.

Dehydrocyclization of paraffins to toluene and xylenes range from 10 to 25% even though calculated on the basis that the naphthenes which are converted dehydrogenate to form aromatics only. No doubt some naphthenes are hydrocracked so the paraffin dehydrocyclization is somewhat greater than calculated. In the production of benzene from the C_6 fraction the catalyst demonstrates a remarkable 5 membered-ring naphthene isomerization activity. Further evidence for this type of activity is shown in Table 5, which shows excellent yields of aromatics obtained when treating a C_7 fraction containing predominantly dimethyl cyclopentane.

Catalyst Life

Since *RD-150* employs platinum as its active agent, it is necessary that it possess excellent resistance to perma-

nent deactivation in order to allow economic application of the process. The catalyst meets this requirement by combining high initial activity, resistance to aging during processing, and resistance to poisoning with regenerability.

Sulfur, nitrogen and water as they normally occur in most feedstocks are not severe poisons to this catalyst. If these materials are present in unusually large quantities or if high severity operations are desired, the temporary poisoning effect can be avoided by preparation of dry feedstock and simple recycle gas treating to take advantage of the full potential life of this catalyst. Processing with clean feedstock or regeneration will remove the effect of processing with large quantities of these temporary poisons.

Extensive investigations have indicated that the presence of arsenic in the feed has little effect if any on the process. Catalyst lives will vary over a wide range depending upon the nature of the feedstock and operating conditions. In general, reformate production varies from 40 to over 200 bbls. per pound of catalyst.

Economics

The question of the specific need of a refiner can be solved by an economic consideration of the factors involved. In general, catalyst cost per barrel of reformate will vary from $0.03 to $0.10 depending upon feedstocks and the octane requirement. A breakdown of total typical operating cost of 21¢ per barrel of reformate is shown in Table 6. Proprietary charges are moderate.

Summary

The new Sinclair-Baker catalyst gives the refiner the advantage of a more flexible and economic catalytic reforming operation. Aromatic synthesis is maximized, more barrels of reformate are produced per pound of catalyst at all octane levels in continuous or regenerative operations, and feedstock pretreating is not required to combat metal or sulfur poisoning. As a result of these improvements, the refiner may select operating conditions to attain higher yields of high octane reformate and of aromatics from a variety of naphthas with reasonable operating and fixed costs.

The M. W. Kellogg Co. is offering the *RD-150* catalyst for fixed-bed units with or without regeneration.

Baker and Co. will contract to manufacture *RD-150* and recover the precious metal value. The catalyst is now produced in Baker's Newark, New Jersey plant and new facilities are being erected to meet increased requirements.

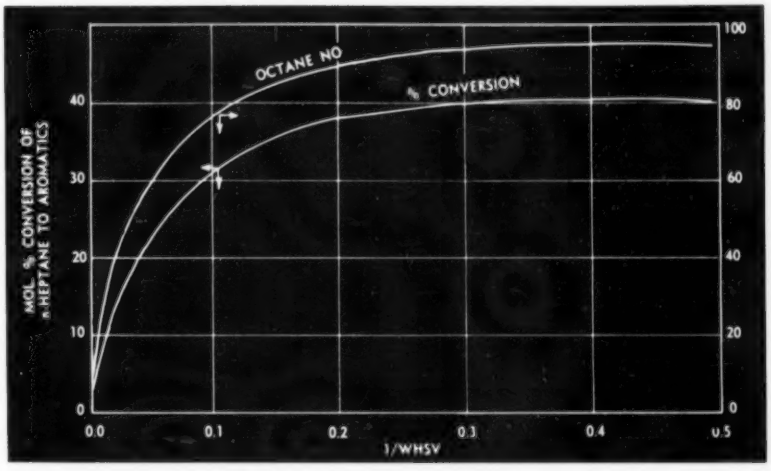

FIG. 5—Dehydrocyclization of n-heptane, at 200 psig., 925° F.

Acknowledgement

The presentation of this paper is made possible through the research efforts of a large group of individuals and makes adequate acknowledgement difficult. The authors wish to cite Messrs. C. D. Keith, J. L. Gring, L. E. Olson and W. E. Stewart of Sinclair Research Laboratories, for their major contribution in this effort, as well as the research staff of Baker and Co. under the direction of Dr. E. P. Rosenblatt. The permission of the Sinclair Research Laboratories for publication of this information is gratefully acknowledged.

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Meet the Authors

John W. Teter received his collegiate degrees from DePauw University and the University of Chicago. Before joining Sinclair, he was with Reilly Tar & Chemical Co., and the Illinois Geological Survey.

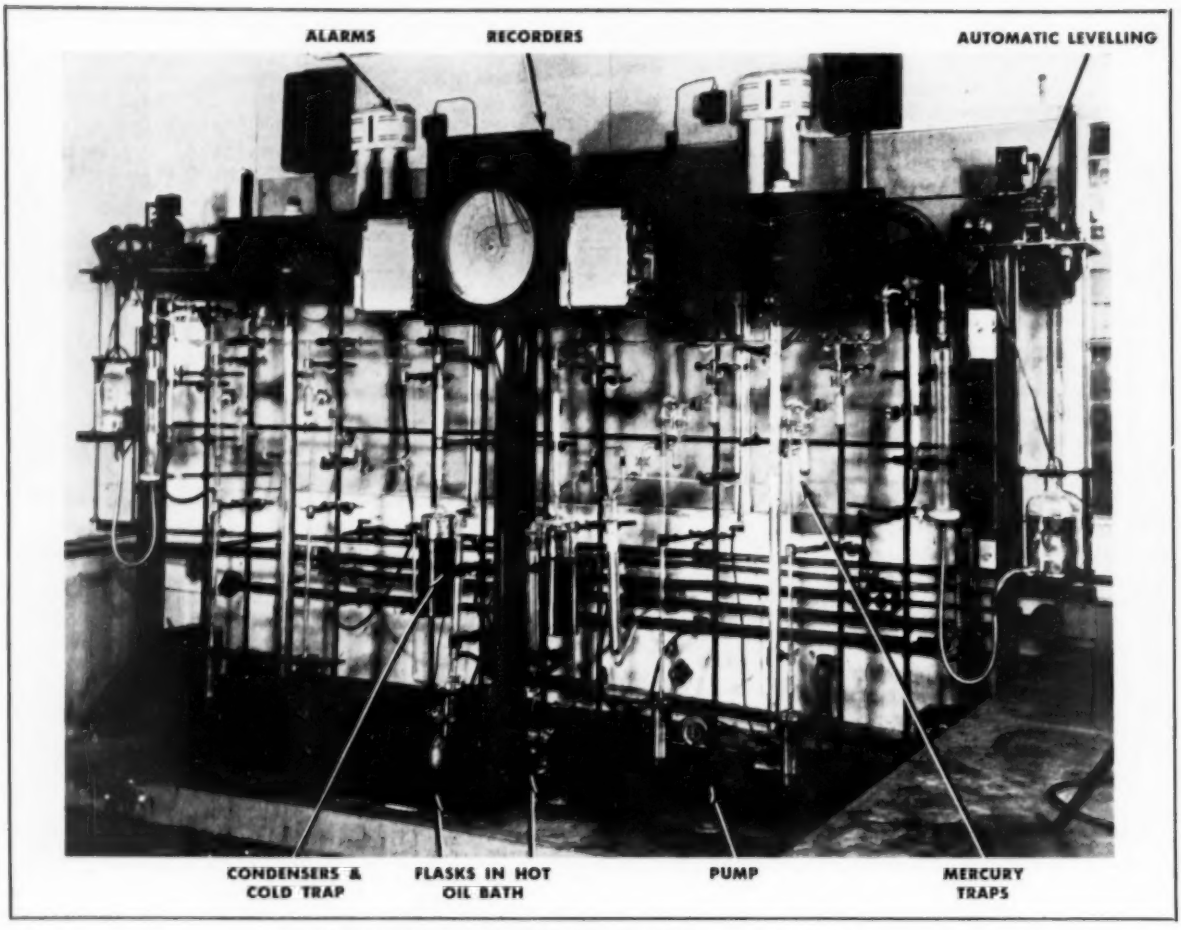
At present he is director of the catalysis research division at Sinclair Laboratories, Inc. He holds 70 U. S. and foreign patents on gasoline anti-oxidants and other petroleum and petrochemical processes. He is an active member of several committees of the American Chemical Society, which he joined in 1934. He is also a co-founder and past president of the Catalysis Club of Chicago, and is a member of the Chicago Chemists Club.

Benjamin T. Borgerson is a chemical engineering graduate of Illinois Institute of Technology. Since 1947, he has been in the research and development department of Sinclair Refining Co. and Sinclair Research Laboratories, Inc.

His recent work in the light oils division has been on catalytic reforming evaluation.

L. H. Beckberger obtained his chemical engineering degree at Ohio State University in 1941, and his master's degree from the University of Wisconsin the following year. He then joined that school's chemical engineering staff, and in 1944 was appointed a research associate for the Rubber Reserve to investigate catalyst performance in the petroleum industry's process for manufacturing butadiene.

In 1946, after receiving his Ph.D. at the Wisconsin school, he joined the catalysis research division of Sinclair Labs. He is a member of the American Chemical Society and the American Institute of Chemical Engineers.



ALL COMPONENTS ARE DOUBLED for faster oxygen absorption determinations in this . . .

Automatic Tester for Oil Oxidation

AN automatic oxygen absorption unit for running two oil oxidation tests simultaneously, developed, built, and in use at the Pure Oil Research & Development Laboratories, Crystal Lake, Ill., is in reality quite simple although rather complicated in appearance, as seen in the photograph above.

Oxygen bubbles through a sample of test oil at elevated temperature, and the rate at which it is consumed is measured and recorded. As seen in the picture, the right side of the unit is a mirror reverse of the left side.

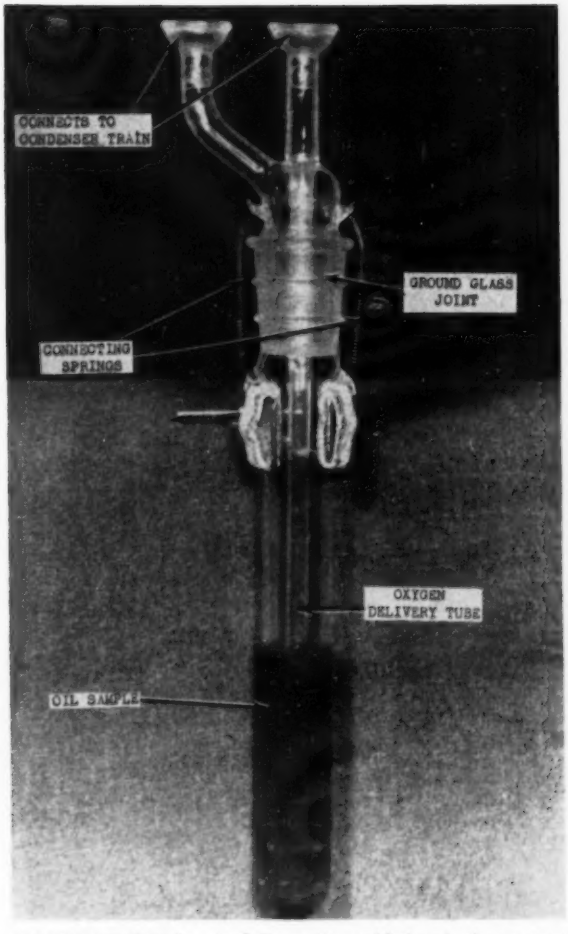
A pump provides constant flow of oxygen, bubbling through the sample of test oil held at constant temperature. The volatile materials escaping from the reaction flask are either condensed and returned by means of a water-cooled condenser or are subsequently removed from the system by condensation at approximately —100° F. in a cold trap.

Carbon dioxide is absorbed by "Ascarite" and water vapor is absorbed by "Drierite". Hence, the unabsorbed oxygen is again available for circulation by the pump. As oxygen is absorbed by the oil, an automatic control system operates to add oxygen from a burette by displacement with mercury.

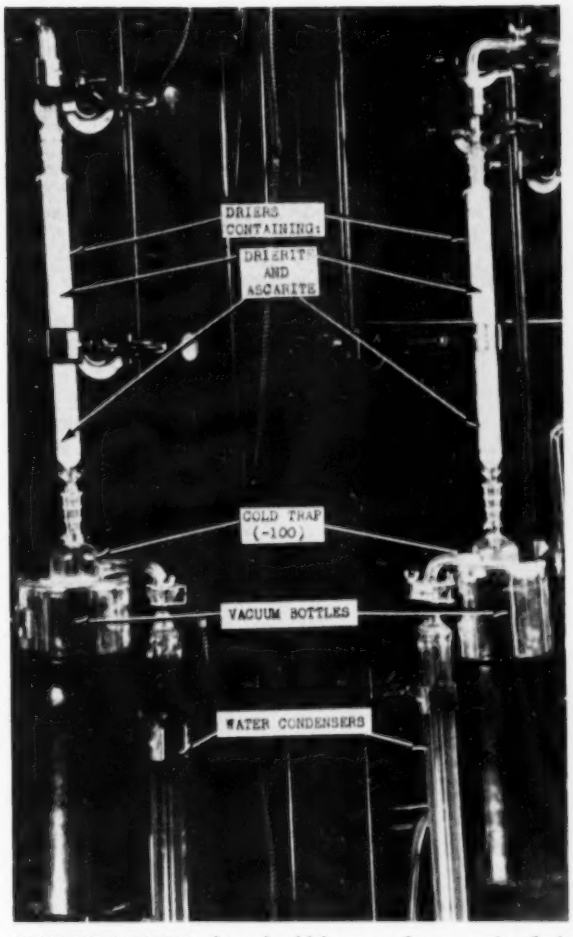
The amount of oxygen which has been absorbed at any specific time by the oil is indicated by the volume of mercury present in the burette. The automatic recorder connected to the leveling device draws a graph of oxygen absorbed vs. time.

The reaction flask (see photograph) is the key part of the entire system. All other components are auxiliaries which assist this flask in its proper performance. When the flask is charged with the normal 30-gm. sample of oil it is approximately half-full, as shown. The glass cover is provided with a central oxygen delivery tube which projects to within ½ in. of the flask bottom.

As oxygen passes through the delivery tube it escapes through four small holes and one large hole at the bottom end of the tube. It mixes with the oil to cause a vigorous bubbling action and results in an oxidation reaction that liberates a certain amount of volatile hydrocarbons and acids as well as other oxidation products. These reaction products are carried along with the oxygen stream through the



REACTION FLASK, heart of the entire oxidation testing system



CONDENSER TRAINS, through which vapors from reaction flask pass

outlet tube and into the condenser.

A conventional water-cooled condenser chills the high temperature reaction products sufficiently to cause the less volatile materials to drop back into the reaction flask. It also relieves the cold trap of some of the latter's heat load. As the unreacted oxygen and its contaminants leave the condenser they enter the cold trap, which is immersed in a mixture of dry ice and methanol at a temperature below —100°F. This is sufficiently cold to liquify any hydrocarbons and any acids formed during the oxidation. (See photograph.)

Leaving the cold trap, the oxygen is dried in the Drierite column and has the CO_2 removed in the Ascarite column. Although the presence of moisture is doubtful following its passage through the cold trap, a certain amount of water vapor is likely to be present in the system during the set-up period (before a test is run), and this is best removed as soon as possible.

The pump maintains oxygen flow to the reaction flask and from the decontamination units. (See photograph.) Each of the two pump pistons consists of a column of mercury moving up and down in a glass tube by the action of a rocking beam driven by an electric motor. The stroke of the mercury pistons is adjustable to a degree by the setting of the eccentric crank which drives the beam.

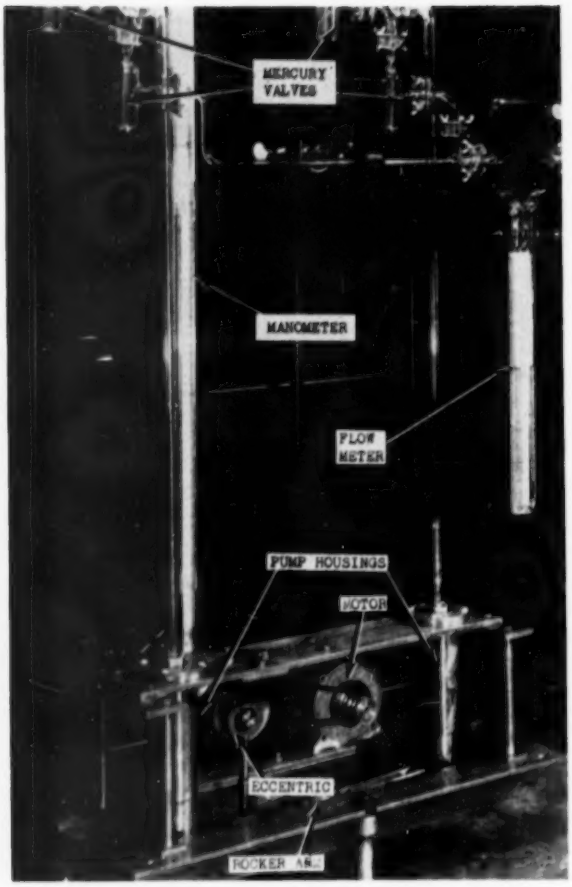
Two mercury check valves (see photograph) are used in conjunction with each pump piston to convert pressure impulses into flow. Each valve permits oxygen to flow through the central tube, bubble through the mercury, and pass through the side outlet. Flow reversal is impossible since pressure at the side outlet acts on the surface of the mercury causing the liquid to rise in the central tube and effectively seal it. By proper arrangement of valves, the oxygen is directed to flow toward the reaction flask and around the system in a loop.

Total output of oxygen from both pistons is delivered at a rate of 12 liter/hr. in pulsations representing approximately 25 strokes/piston/min.

One leg of a mercury manometer is connected to the system at a point between the dryer column and the pump. The other leg of the manometer is open to the atmosphere and is equipped with an electrical contact device. (See photograph.) This latter is relatively simple, consisting merely of two wires, one somewhat longer than the other and mounted in such a way that both wires may be moved up or down as a unit by an adjusting screw at the top of the column.

In normal operating position, the mercury is in contact continuously with the longer wire and touches the shorter one intermittently as the pressure varies. The system pressure is regulated to be approximately 2 mm. Hg. greater than atmospheric; so that if any leak should occur, it would be outward causing the apparatus eventually to shut off automatically.

Outside the path of circulating oxygen is an auxiliary supply of the gas in a burette of 500 cc. capacity. This reserve oxygen is introduced to the circulating system by displacement



PUMP AND VALVE SYSTEM, which maintains oxygen flow in the apparatus

MERCURY VALVES convert pump piston impulses into smooth flow

with mercury as pressure drop indicates a demand.

The mercury used to displace oxygen in the burette is contained in a leveling bottle connected to the former by a flexible plastic tube. The liquid tending to seek the same level can be made to flow from the bottle to the burette by raising and lowering the bottle.

An electrical-mechanical follow-up system is provided for moving the leveling bottle automatically to provide additional oxygen to the circulating system as needed. (See photograph.)

As oxygen is consumed by the oil, the pressure in the closed system tends to drop. This is "felt" by a mercury manometer, one leg of which is open to the system and the other open to the atmosphere. The resulting movement of the mercury column breaks an electrical contact which operates through an electronic relay to drive a motor in such a direction that the bottle of mercury is lifted. As the bottle moves upward the mercury, seeking its own level in the burette of oxygen connected to the leveling bottle, causes oxygen to be displaced from the burette into the system. This again raises the pressure and causes the motor to reverse. The electronic relay provides no "off" position for the motor. It runs one way or the other at all times so that the leveling bottle moves up and down continuously, hunting the equilibrium position.

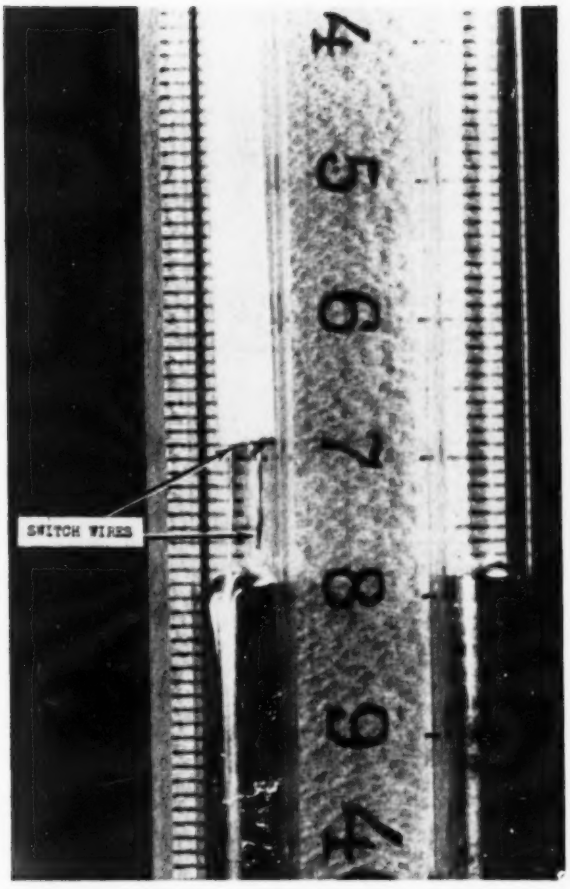
A reservoir recessed in the base platform holds the reaction flask and its contents at selected constant temperature. The bath holds about seven gal. of oil ("Ucon LB 300X" synthetic) and is arranged to heat both flasks simultaneously. Consequently both sides of the apparatus, when operating at the same time, must operate at the same temperature.

Three heaters in the reservoir are: a 500-watt and a 750-watt Variac adjusted heater, each independently controlled by switches on the control panel; and a 250-watt heater operated intermittently by the thermo-regulator relay circuit. A toggle switch permits selection of either the 300 or 325° F. fixed-point Princo regulators. Regulators are calibrated and adjusted during manufacture; other temperatures are available only by changing the units.

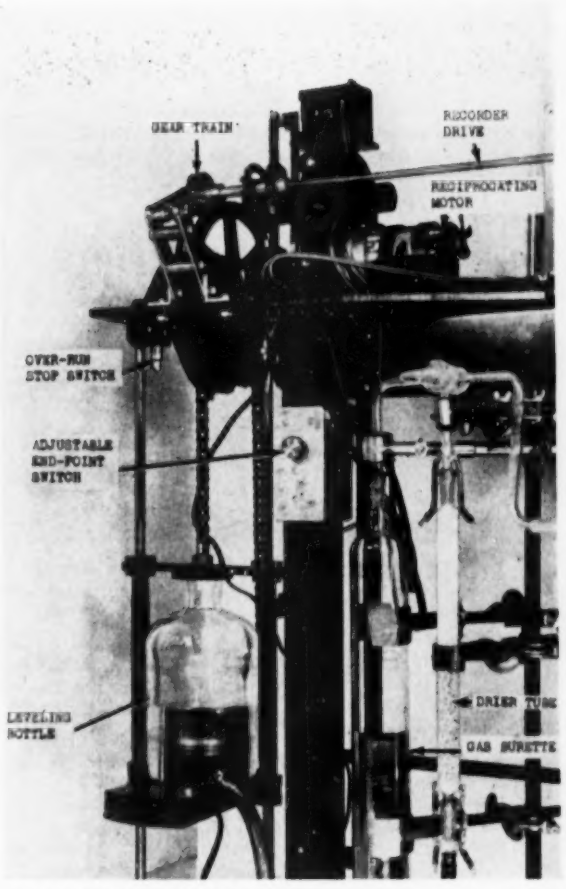
A stirrer assures uniform bath temperature, and a Brown two-pen recorder maintains continuous record of bath and room temperatures. Any fumes from the bath are picked up by blowers and directed into the exhaust duct system of the building.

A three-way glass valve at the top of the burette permits a variety of operating positions: 1) open to burette, circulating system, and oxygen supply; 2) open to burette and circulation, closed to supply (the normal running position); 3) open to burette and supply, closed to circulation; and 4) open to supply and circulation, closed to burette.

Running a test requires some "set-up" preliminary to the actual run. All glass parts must be clean and free of any contamination from previous tests.



MANOMETER UNIT keeps system pressure slightly above atmospheric



AUTOMATIC LEVELING DEVICE and oxygen supply portion of system

Components must be correctly assembled and carefully checked for leaks in the system.

Heaters for the constant temperature bath are turned on, and 30 gms of the test oil are weighed into the reaction flask.

Next, the Dewar flask for cooling the cold trap is filled about half way with methanol to which is then added very slowly—to prevent bubbling over—small pieces of dry ice, until the flask is completely full. Solid pieces of dry ice are heaped up over the cold traps as much as possible, and then are covered with two or three shop towels for insulation to prevent condensation of moisture from the air. Dry ice will have to be added morning and evening until the test is completed.

When the bath is up to temperature the reaction flask is connected to the system. The three-way cock is set to close off supply and open the burette to the system. The vacuum valve is opening very slowly to prevent siphoning the mercury from the check valves or surging of the oil sample in the reaction flask, and the mercury is brought up to the top of the burette by raising the leveling bottle.

When minimum pressure is attained as indicated by the manometer, the the vacuum valve is closed. If the pressure differential in the manometer is unaffected for one to two minutes, it may be assumed the system is free of leaks.

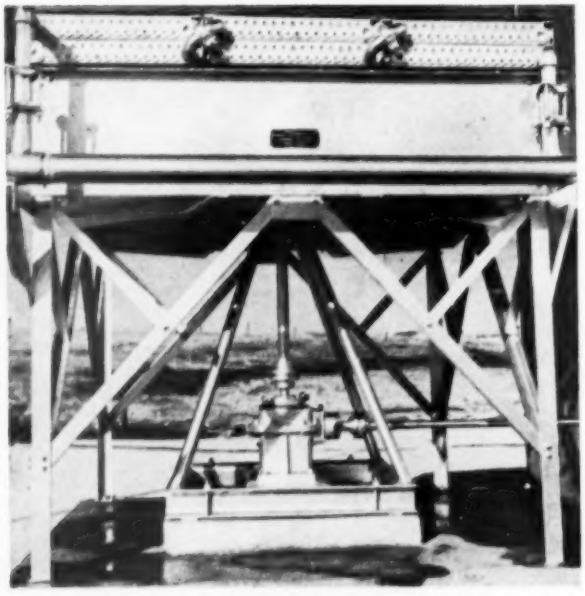
Then, the brass needle valve in the oxygen line is opened (pressure regulator set to approximately 3 psi.) and the glass valve at the burette is very carefully turned to permit oxygen to enter the system until equilibrium is reached. The cock is then turned to shut off the supply and the vacuum valve is again opened.

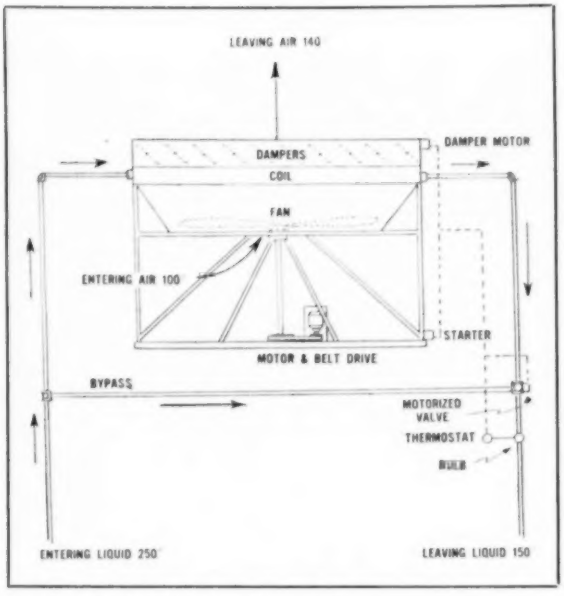
This excavation procedure is repeated ten times, then the system is charged with oxygen while the leveling bottle is lowered until the mercury is at the zero mark on the burette. The final pressure in the system is adjusted to about 2mm. Hg. above atmosphere, so that any leaks which may develop will be outward. The recorder pen is set at the left end of the chart.

The run is then ready to start by energizing the electrical system. This includes turning on automatic leveling, reset button, and signal system. The unit then operates automatically until the arm on the leveling bottle support engages the adjustable microswitch. This switch is usually set for an end point of 500 cc. of absorbed oxygen. When tripped it sets off the alarm system and shuts off the pump and the automatic leveller.

Although the reaction flask should be removed from the bath as soon as possible after completion of the test, it is not mandatory since with no oxygen circulation there should be no appreciable effect on the oil for some time.

The oxygen flow rate regarded as standard for this apparatus is 12 liter/hr. and must be determined as closely as possible. A sensitive gas flow meter can be connected to the pump discharge line and adjustments made to the pump eccentric to correct the flow rate.





FLUID COOLER (left) with diagram (right) showing location of automatic controls

WHEN AND WHERE TO USE

Air-Cooled Heat Exchangers

By JAMES M. WHALEN
The Trane Co.

UNTIL a few years ago water-cooled heat exchangers, principally cooling towers, handled most of the cooling and condensing jobs in the petroleum industry. Now it appears the air-cooled heat exchanger, or dry-type cooler, offers advantages for many plant jobs and along gas pipe lines, especially when water is scarce or unsuited for cooling use without extensive treatment.

Water-saving is not the only advantage of the air cooler. Among others are lower maintenance in labor and materials, lower operating costs and freedom from many of the problems which severe winter weather brings to cooling towers. The dry type fluid cooler will not eventually replace the familiar cooling tower, for there are many applications where water always will be the most economical and efficient method. But the choice of two basic methods gives the plant designer greater freedom than ever before in solving cooling problems.

The air-cooled heat exchanger, fluid cooler, or dry-cooler as it is variously termed, is a simple device mechanically. It consists essentially of nothing more than an extended heat transfer coil, or coils, and a fan, mounted on a framework. One or more fluids flow through the coils as the fan either forces or sucks the surrounding air through them to effect heat transfer. Dampers, baffles and other arrangements may be added to further control air flow, and thermostats to control effluent fluid temperature. The device is readily susceptible to automatic control and installation in remote or relatively inaccessible locations.

Whether or not a fluid cooler is preferable to the cooling tower or evaporative cooler in a given process application depends on several factors, the most important being the following:

1—Availability and quality of water supply.

2—Temperature requirements of the fluid cooled.

3—Temperature of the air and available water.

4—Pressure of fluid cooled.

5—Maintenance and operating cost considerations versus first cost.

6—Installation limitations, i.e., space, location, etc.

Where water is scarce, expensive, inaccessible or dirty, the dry type fluid cooler usually offers the best solution to almost any gas or liquid cooling or condensing problem. Since air is the cooling medium, it requires no water, no water make-up, no water treatment, and no pumping or piping for cooling water. All these, with the possible exception of water treatment, are necessary with every cooling tower installation. On the other hand, if adequate water at the proper temperature is available and requires little or no treatment, a cooling tower or similar unit may be best. In some cases, a large water supply can eliminate the need for a cooling tower also.

The cooling capacity of the fluid cooler is limited by the design dry bulb temperature of the air. Ordinarily, a fluid cooler can cool fluids from 1500° F. to about 120° F., depending on the design dry bulb temperature. Where fluids must be cooled below this point, a cooling tower or evaporative cooler must be used, either alone or supplementing an air cooling unit, because cooling tower capacity is based on the design wet bulb temperature.

One type of installation frequently used to cool fluids below the dry bulb temperature combines the fluid cooling unit with a cooling tower or an evaporative cooler. The fluid cooler brings the temperature down to about 160-140° F. and the cooling tower lowers the temperature further to a

Table 1—Estimated Costs of Fluid Cooler Units For Petroleum Processing Applications

Duty	Total Load Btu/hour	Temperature °F In	Temperature °F Out	Operating Pressure psig	No. of Fans (Units) Required	Total BHP	Estimated Cost of Fluid Cooler Units
Vacuum Residium	13,800,000	300	250	75	1	42.8	19,700.00
Hydrocarbon Liquid	3,539,000	233	105	460	1	26.0	25,700.00
Fractionator Reflux	22,185,000	225	150	25			
Light Fuel Oil	3,660,000	447	150	215	2	83.9	26,500.00
Vacuum Jug Reflux	3,858,000	500	200	150			
Vapor	8,481,000	220	150	5			
Vapor	5,720,000	235	175	10	1	39.6	18,600.00
Debutanizer Bottoms	9,800,000	256	125	155	1	39.6	11,100.00
Debutanizer Overhead	16,720,000	145	122	155	6	237.6	63,900.00
Fractionator Overhead	51,370,000	275	125	1	7	191.1	73,200.00
Gasoline Vapor	9,620,000	245	150		1	48.3	24,000.00
Reactor Effluent	11,300,000	300	150		1	48.3	28,900.00
Gasoline Bottoms	3,700,000	295	150		1	8.45	6,800.00
Hydrocarbon Vapor	3,710,000	235	150		1	14.85	11,700.00

point that approaches the wet bulb.

The combination type installation may be shown best in an illustration: Assume the admittedly extreme case where a fluid must be cooled from 2000° F. to 90° F. Passing through a shell and tube exchanger, the fluid is cooled to about 1500 or 1000° F. by a stock-to-stock exchange, where previously-cooled, recirculated fluid is used as the cooling medium. The fluid at 1500-1000° F. then passes through a dry type fluid cooler, where it is cooled to between 180-130° F. For the additional sub-cooling or condensing, a cooling tower system is used to lower the fluid temperature to 95-90° F.

In another installation of this type, the designer was able to use a two-cell water cooling tower with dry type fluid coolers instead of a much more expensive 24 cell tower.

An important factor to consider is the effect of high fluid temperatures on the units. At entering temperatures above 160° F., there is a considerable increase in the amount of scale which forms on the outside of tubing in a cooling tower or evaporative cooler. There is no chance for such formations to take place in an air cooled unit, so fluid coolers are particularly well suited to handle fluids at temperatures above 160° F.

The fluid cooler is better adapted to handle extremely high temperatures and large temperature differences than many types of water coolers because of its basic construction. The unit has no heavy casing to be harmed by thermal shock, and the responsive extended surface coil carries heat away from the fluids quickly and uniformly. Fluid coolers are often designed so the coil can expand and contract freely without affecting the structure.

Because the fluid cooler uses the surrounding air as its cooling medium, the temperature of that air can affect the operation of the unit. If the unit is installed indoors or in warmer climates, variations in air temperature probably will not present too much of a problem. In colder climates, however, it may be necessary to take precautions against freezing of fluids in the tubes of the unit.

Often temperature controls provided by the unit itself can compensate for varying air temperatures as illustrated in the schematic diagram. Many fluid cooling units have dual-speed fan motors or fans with adjustable-pitch blades; both allow regulation of the volume of air passing over the coils. Others achieve the same results with shutters or dampers to control the air flow over the coils and the rate of heat transfer. Still another common method of controlling the amount and rate of cooling is a by-pass system where a thermostatically controlled valve by-passes a portion of the fluid around the cooling coils when the air temperature is below a certain point. This keeps the final temperature of the fluid from falling below the required level.

In some successful fluid cooler installations in colder zones, the unit has been housed in a shelter and the surrounding air warmed by unit heaters or space heaters. However, these more elaborate installations are often unnecessary, especially in milder climates. The volume and capacity controls built into units usually can provide constant heat transfer results with normal air temperature fluctuations. Fan pitch may be adjusted seasonally.

There are many places where a cooling tower can be used to good advantage and installed at a lower first cost than a comparable fluid cooler. However, other factors must be considered if the two units are to be compared on an equal basis. Estimated costs of some typical air-cooler installations are given in Table 1.

First are the actual costs of in-

Meet the Author

James Whalen received his degree in engineering from Iowa State University in 1948. That same year he joined the Trane Co. Completing that firm's graduate training course, he later was placed in charge of the fluid cooler sales division. In October, 1951, he gave an address before the American Institute of Chemical Engineers on the subject he discusses in the accompanying article. At present he is manager of the Trane Co.'s convector sales department.

stalling and erecting the units. On a cooling tower installation where the units costs $15,000, the cost of erection and the required concrete basin will run about $2,000. The erection and foundation costs for a comparable fluid cooler installation would probably be about $175.

The other vital factors in the relative cost pictures of the two types of units are the operating costs, maintenance costs and the costs of water, water treatment and water pumping. Too often, the choice is made on the basis of first cost alone. Then within a few months, the "hidden' costs crop up to put the whole process on a wasteful operating level. A comparison of annual costs for both types of unit are given in Table 2.

Operating costs of both forced or induced draft cooling tower and the fluid cooler will include the horsepower required to drive a fan. This will be about the only operating cost for the fluid cooler. The cooling tower's operating cost, however, must also include the costs of pumping and treating the cooling water. The cost of the water required to make up losses due to evaporation and drifting from the cooling tower can contribute another substantial sum to the operating costs of that unit. This factor alone can rule out the selection of a cooling tower where water is scarce, expensive or inaccessible.

Table 2—Annual Cost Comparison Fluid Coolers vs Cooling Towers

Conditions: 4 row coils, 700 ft./min. face velocity 140 F. condens'ng temperature (Note: Fluid coolers are at an advantage with the higher temperatures; lower condensing temperatures generally favor cooling towers).

	Fluid Cooler	Cooling Tower
First Cost*	$390,000	$790,000
Power Cost	538,000	365,000
Maintenance Cost** (less fluid cooler maintenance)	——	100,000
	$928,000	$1,255,000
Life Expectancy***	(Closed Condensers) 17 years	7 years

* Yearly apportionment = $\frac{\text{(First Cost} - \text{Salvage)}}{\text{Life Expectancy}}$

** Unit maintenance plus added maintenance on surrounding buildings. Based on actual experience.

*** In accordance with standard depreciation allowances.

The fluid cooler, of course, requires no water treatment or make-up. And the fluid cooler's one operating cost, horsepower to run the fan, often can be held to a minimum through the use of a two speed motor. A unit with a two speed motor uses only one-eighth of the design horsepower when it runs on the low speed. And in many cases, the fluid cooler may handle the cooling load satisfactorily with its fan running on low speed as much as 80% of the time. Such cases occur when the air temperature drops low enough for the cooling load to be handled with a reduced air volume and reduced fan speeds.

For example, the fluid cooler in one installation was selected on the basis of 100° F. air, with the fan running at top speed only when the air was above 90° F. When the air temperature dropped below 90° F. the fan ran at low speed, using only one-eighth of the motor's rated horsepower. Below 55° F. the fan shut off completely, and natural convection currents over the unit's coils handled the cooling load with no power consumption at all.

Maintenance costs for the cooling tower may run as much as three times those for comparable fluid cooler installations. Close supervision is desirable to maintain the proper amount and distribution of the spray water coolant through the cooling tower. Too much water can result in poor circulation and excessive water loss through evaporation and drifting of vapor, thus raising the operating costs of the unit. Also, if there is too much water vapor blowing from the unit, nearby buildings and equipment may be damaged by the moisture; the cost of this extra up-keep must be considered. Too little water in the cooling tower lowers the capacity of the unit and results in poor circulation and inefficient cooling through the tower.

The delicately-balanced water supply to and through the cooling tower is upset by dirty or clogged nozzles or troughs. Many cooling tower manufacturers recommend semi-annual inspections of the unit's decking and basin for dirt, sludge and contamination. This may require semi-annual or annual shut-downs for cleaning sludge out of the basin or scum from the core. Very often, weekly inspections of the water collecting basin are necessary to keep the unit operating efficiently.

Water treatment and unit maintenance costs for evaporative coolers are about the same as for cooling towers. There will be less water make-up, however.

Ordinary maintenance on fluid coolers is limited to infrequent cleaning of the extended surface coils. Normally this can be done with a brush. Every four or five years, however, it may be necessary to use steam or compressed air to clean accumulated dust, lint, or insects off the coil surfaces. The frequency of this work is determined by location. The mechanical maintenance of fan, belt or gear drive and motor will be about the same for the fluid cooler as for the cooling tower.

Where space is a factor in an installation, the fluid cooler may have a special advantage. It requires a small foundation and no basin, and requires much less space than a comparable cooling tower installation. For this reason, the fluid cooler is also suited to pilot plant jobs, where the installation will be used for a short period of time and then moved to another location. It is much cheaper to move and re-install a fluid cooler than a cooling tower.

Fluid cooler installations can be virtually tailored to suit particular needs. Unit cores, heaters, fans, drives and prime movers all can be selected to meet specific requirements.

Extended surface coils, making up the core of the fluid cooler, can be any one of four different types. These are:

1—*Flat Tube Radiator Type Core*—One of the most efficient heat transfer surfaces yet developed. Used in automobiles. Highest capacity per pound of material or square foot of surface. Lowest pressure drop per Btu capacity. Restricted to low pressures. Not mechanically cleanable. Temperature range limited by solder bonding.

2—*Helical Wound Fin and Round Tube Type Core*—Fins can be smooth, corrugated or sheared. Most efficient of round tube type cores. Relatively high pressure drop per Btu output. Generally solder-bonded, but more recent designs use no bonding material.

3—*Integral Finned Tubing*—Extended surfaces extruded from heavy-walled tubes. Extended surface in concentric fins or spines. Generally, same operating characteristics as helical wound fin.

4—*Plate type Fin and Round Tube*—Tube openings in fins are collared, tubes are mechanically expanded into fins for solderless bonds. Uses most external surface per Btu output. Lowest pressure drop per Btu output of round tube designs. Easily cleaned.

Three different types of headers may be chosen for the unit core, depending on pressure, temperature

range and cleaning requirements of the application.

For installations where frequent coil cleaning will be necessary, headers with removable header plates are available to give the maintenance crew complete and easy access to coil tubes. These bolted-on header plates are not adapted to handling high pressures, however.

Better adapted for high pressure work and still cleanable are headers having removable plugs opposite the tubes. These plugs may develop leaks or become stuck after years of use.

If at all practical, if the fluid being cooled or condensed will not foul the tubes, initial cost of the installation can be reduced by using mechanically non-cleanable coils. These employ a welded header arrangement with pipe headers and U-bends.

For most fluid cooler applications, the most efficient fan is the axial flow propeller type. This fan often has adjustable pitch blades to allow control over the air volume and horsepower consumption. The fan may be driven through a gear reducer or belt drive or it may be direct-driven. The gear reducer is more expensive initially than a belt drive, but the belt drive requires more maintenance.

The prime mover for the fluid cooler fan can be an electric motor, an internal combustion engine or a steam turbine. The gas engine, with its variable speed operation, will afford savings in power consumption. However, a dual-speed electric motor can effect power savings.

The internal combustion engine and steam turbine will give smaller increments of control (or speed variations) than the two-speed motor. However, electric motors are better suited to unattended operation. Final selection of type of driver will depend to a great degree on the availability of fuels or power.

Where the fluid cooler is installed in a corrosive atmosphere and where the fluids handled are corrosive, special materials may be necessary. Fluid coolers and their coils have been made from a wide variety of materials, including monel, inconel, and many ferrous and non-ferrous alloys. One large installation uses all-aluminum units for its engine cooling jobs.

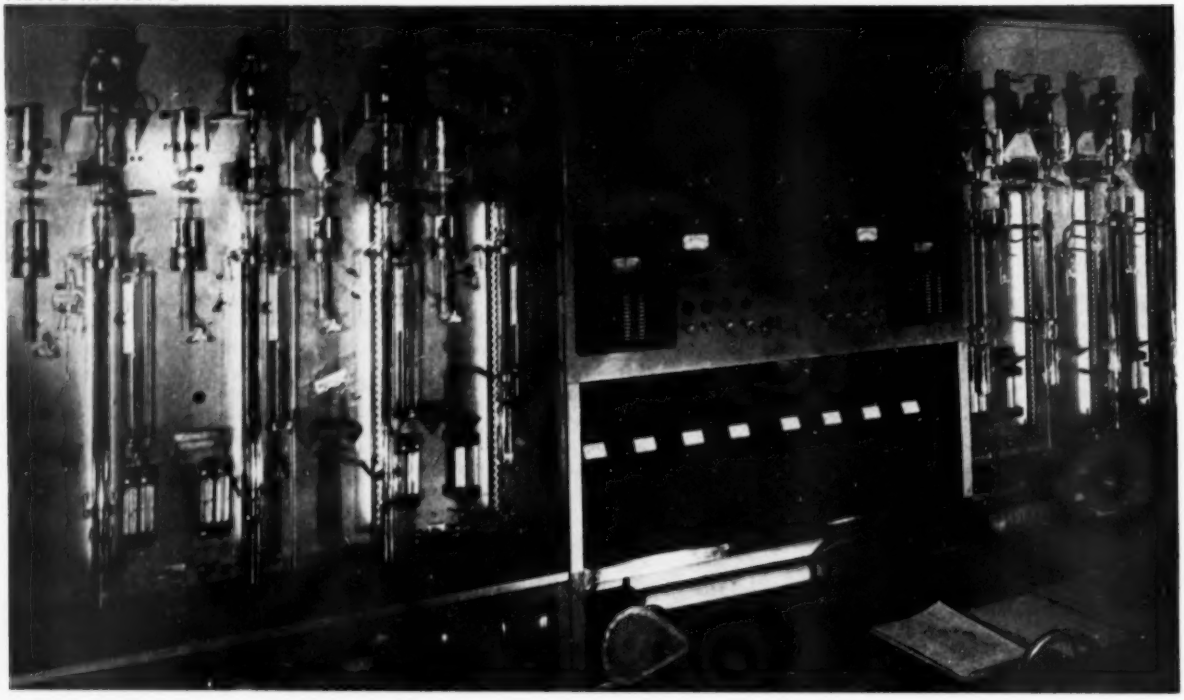
When only the fluid handled is corrosive, only the coils must be of special materials. These include copper, aluminum, steel, stainless steel, monel, inconel, Admiralty and red brass.

Fans also can be constructed of cast aluminum, laminated wood and plastic. The framework can be built of special metals or coated to resist corrosion, and special paints can be used to protect the units from corrosion, weather, rust, mildew or fungi.

NEWS in VIEWS

FIRST PLASTIC TANK TRUCK goes into service carrying formaldehyde and similar chemicals. The 3400-gal. transport is made of American Cyanamid Co.'s "Laminac" polyester resin and fibrous glass reinforcement. Weighing 34% less than its steel counterpart, it is expected to increase payloads $3000 annually without exceeding legal road load limits.

PETROCHEMICAL PLANT MAINTENANCE. Fractionating towers at Houston, Texas, plant of Shell Chemical Co. undergo periodic cleaning operation. Long boom on the mobile yard crane lifts the bubble trays to the top of the columns, where maintenance crewmen guide their installation through the opened top flange heads.



PRECISION FRACTIONATION as conducted in this battery of eight miniature stills at Standard Oil Co. (Indiana)'s Whiting laboratories for research on such materials as aviation gasoline, synthetic lubricants and detergents, plastics and plasticizers, and petrochemicals such as paraxylene. Units can operate with only an ounce of liquid, producing fractions of about 0.02 oz. each. Such minute cuts are used for further study with spectrometers, chromatography, and other procedures.

HE ALSO SERVED IN KOREA. Oil man with the 4th Quartermaster Corps Petroleum Products Laboratory at Pusan during the recent conflict was Pfc. Edward G. Elste, of Esso Standard Oil Co., Baltimore, shown here running a routine distillation on an aviation gasoline sample from the airfields in the Pusan area. *(U. S. Army Photo)*

WATER IS THE CULPRIT. Special Shell Oil Co. apparatus shows water is cause of tank corrosion. Fuel samples are measured into cups, each of which is precisely 0.002 in. thick and has small depression at bottom. Without Shell's new corrosion inhibitor, water caused leaks in as little as 82 days. Fuel itself was found to have no effect on corrosion rates.

TO HELP YOU DESIGN FRACTIONATORS

Distillation of Quaternary Mixtures

Complete Columns—Partially Distributed Components

No. 8 in a Series

By ROBERT R. WHITE
Dept. of Chemical and Metallurgical Engrg.
University of Michigan

THE preceeding article considered the separation of quaternary mixtures into distillate and bottom products which always contained all of the components by specifying the concentration of the most volatile component in the bottom product and the concentration of the least volatile component in the distillate product. This article considers cases in which the separations are so specified that some of the components disappear in the calculation of infinite stage columns.

Specification of x_{dD} and x_{dB}

A method of specifying the separation of a quaternary mixture of components *a*, *b*, *c* and *d* consists of fixing the composition of the least volatile component, *d*, in both the distillate and bottom products. This problem is not only interesting theoretically but also practically, since one of the major industrial purposes of distillation is the relatively complete separation of either the most volatile or the least volatile component of a complex mixture. A successive repetition of such an operation serves to completely separate a complex mixture. The specification of the concentration of the least volatile component, x_d, in both the distillate and bottom products says, in effect, that only a limited amount of component *d* will be permitted in the distillate product and the remainder must be in the bottom product. By sharply limiting the amount of *d* in the distillate substantially a ternary distillate can be produced.

The following illustrative example will be used in discussing this case.

Example: A saturated liquid feed stream containing 25.0 mol % each of components *a*, *b*, *c* and *d* having relative volatiles of 3.375, 2.25, 1.50 and 1.00, respectively, is to be fractionated to produce a distillate product containing 1.0 mol % of component *d* and bottom products containing various percentages of component *d*. Determine the range of product variation with reflux ratio and with various concentrations of component *d* in the bottom product.

Solution: The method of specifying the separation is illustrated in Figs. 1-9.

Total Reflux Calculations

The procedure for calculating the number of stages required at total reflux to make products meeting the specifications x_{dD} and x_{dB} may be summarized as follows, using the relationships derived in preceding articles.

1—Assume x_{aB}.

2—Calculate x_{aD} from the material balance Equation 2.

$$\frac{x_{aD} - x_{aB}}{x_{aF} - x_{aB}} = \frac{x_{dD} - x_{dB}}{x_{dF} - x_{dB}} \quad \ldots\ldots(1)$$

or rearranging

$$x_{aD} = x_{aB} + (x_{aF} - x_{aB}) \frac{x_{dD} - x_{dB}}{x_{dF} - x_{dB}} \quad \ldots\ldots(2)$$

3—Calculate the number of stages N from Equation 12 Art. 7.[1]

$$N = \frac{\log \frac{x_{aD}}{x_{aB}} \frac{x_{dB}}{x_{dD}}}{\log \alpha_a / \alpha_d} \quad \ldots\ldots(3)$$

4—Calculate the values of B and C from Equations 15, Art. 7.[1]

$$A(\alpha_b^N - \alpha_d^N) + B(\alpha_d^N - \alpha_a^N) + D\alpha_a^N - \alpha_b^N) = 0 \quad \ldots\ldots(4)$$

from which

$$B = \frac{A(\alpha_b^N - \alpha_d^N) + D(\alpha_a^N - \alpha_b^N)}{(\alpha_a^N - \alpha_d^N)} \quad \ldots\ldots(4a)$$

and similarly

$$C = \frac{A(\alpha_c^N - \alpha_d^N) + D(\alpha_a^N - \alpha_c^N)}{(\alpha_a^N - \alpha_d^N)} \quad \ldots\ldots(5)$$

where

$$A = \frac{x_{aF}}{x_{aB}}, B = \frac{x_{bF}}{x_{bB}}, C = \frac{x_{cF}}{x_{cB}}, D = \frac{x_{dF}}{x_{dB}}$$

5—Calculate x_{bB} and x_{cB} from B and C.

6—Test the assumption of x_{aB}, Step 1 by determining whether, $(x_{aB} + x_{bB} + x_{cB} + x_{dB})$ is equal to 1.0.

For the example problem the results of total reflux calculations for $x_{dD} = 0.01$ and various values of x_{dB} are summarized below.

Bottom Product Composition at Total Reflux

$x_{dD} = 0.01$

x_{dB}	0.340	0.442	0.517	0.600	0.800
No. of Stages	4.23	5.06	5.73	6.47	8.79
Component					
a	0.101	0.030	0.011	0.004	0.0002
b	0.239	0.160	0.097	0.0504	0.007
c	0.320	0.368	0.375	0.346	0.193
d	0.340	0.442	0.517	0.600	0.800

Finite Reflux Ratios

As with ternary systems, the calculation of stage requirements and product composition as a function of reflux ratio and feed location, involves the assumption of the complete bottom (or distillate) product composition, a checking of the distillate (or bottom) product composition calculated by a material balance with that produced from stage to stage calculations.

Reboiled Rectifying Columns—Infinite Stages

The performance of reboiled rectifying columns having an infinite number of stages is limited by the equilibrium tie line originating in the specification plane for the bottom product, x_{dB}, which extrapolates through the feed point, F, analogous to those cases discussed in Art. 7[1] and for ternary systems in Art. 5, Figures 8 and 10.[2] These tie lines are conveniently located by using Equation 17 of Art. 7 written as

$$A(\alpha_b - \alpha_d) + B(\alpha_d - \alpha_a) + D(\alpha_a - \alpha_b) = 0 \quad \ldots\ldots(6)$$
$$A(\alpha_c - \alpha_d) + C(\alpha_d - \alpha_a) + D(\alpha_a - \alpha_c) = 0 \quad \ldots\ldots(7)$$

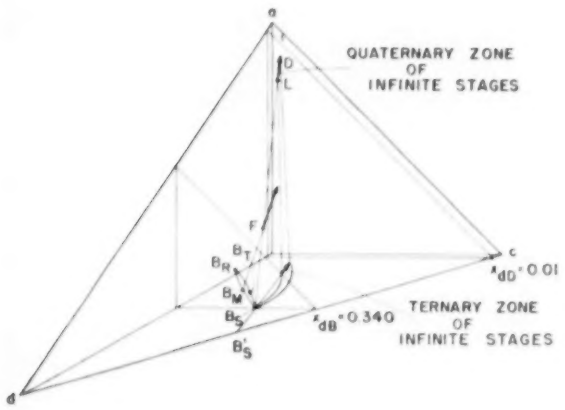


FIG. 1

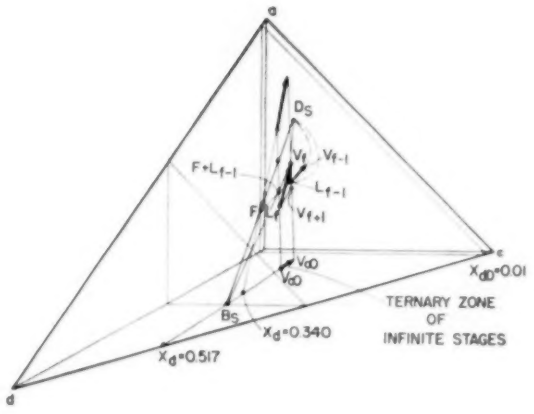


FIG. 2

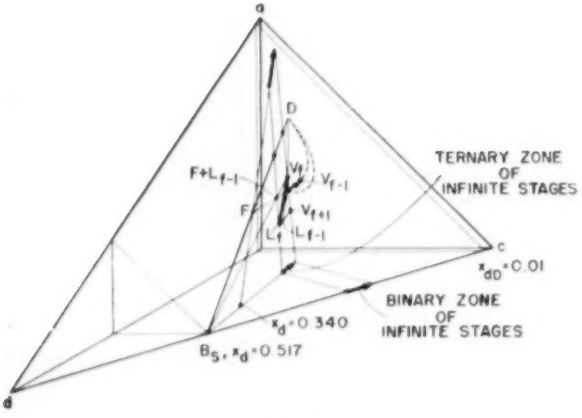


FIG. 3

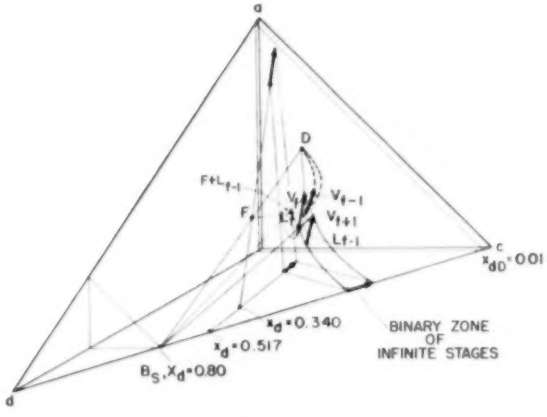


FIG. 4

where

$$A=\frac{x_{aF}}{x_{aB}},\ B=\frac{x_{bF}}{x_{bB}},\ C=\frac{x_{cF}}{x_{cB}},\ D=\frac{x_{dF}}{x_{dB}}$$

The procedure is as follows:

1—Assume x_{aB}.

2—Calculate B from Equation 6 and C from Equation 7.

3—Calculate x_{bB} and x_{cB} from B and C.

4—Test the assumption of x_{aB} by determining whether $x_{aB}+x_{bB}+x_{cB}+x_{dB}$ is equal to 1.0.

When this procedure is used at various specifications of x_{dB} the resulting values of the compositions of the bottom products are as shown below.

Bottom Product Composition for Reboiled Rectifying Column with Infinite Stages, x_{dD} = 0.01

x_{dB}	0.340	0.442	0.517	0.600	0.800
Component					
a	0.165	0.112	0.087	0.064	0.030
b	0.218	0.173	0.144	0.113	0.034
c	0.277	0.273	0.252	0.223	0.136
d	0.340	0.442	0.517	0.600	0.800

Refluxed Stripping Column with Infinite Stages

The performance of a refluxed stripping column containing infinite stages is limited by the equilibrium tie line terminating in the specification plane for the distillate product, x_{dD}, which extrapolates through the feed point, F.

In the example, x_{dD}=0.01 and this tie line is conveniently calculated from Equation 16 of Art. 7.[1]

$$A\alpha_a(\alpha_b-\alpha_d)+B\alpha_b(\alpha_d-\alpha_a)+D\alpha_d(\alpha_a-\alpha_b)=0 \quad \ldots\ldots(8)$$

$$A\alpha_a(\alpha_c-\alpha_d)+C\alpha_c(\alpha_d-\alpha_a)+D\alpha_d(\alpha_a-\alpha_c)=0 \quad \ldots\ldots(9)$$

where

$$A=\frac{x_{aF}}{x_{aD}},\ B=\frac{x_{bF}}{x_{bD}},\ C=\frac{x_{cF}}{x_{cD}},\ D=\frac{x_{dF}}{x_{dD}}$$

by a procedure which is virtually identical to that for the reboiled rectifying columns. When this procedure is used for the example problem the resulting distillate product composition, its equilibrium liquid and the extrapolation of the tie line to x_a=0 is as presented below and illustrated by Fig. 1.

Equilibrium Tie Line Terminating at y_{dD} = 0.01 and Passing Through Feed Point

Component	Distillate Product Composition y_D	Equilibrium Liquid x	Bottom Product at x_a = 0
a	0.9254	0.8645	0.000
b	0.0457	0.0641	0.325
c	0.0189	0.0397	0.335
d	0.0100	0.0317	0.340

As long as the bottom product is specified so as to contain less than 0.340 mol fraction of component *d*, the tie line terminating in y_{dD}=0.01 and passing through the feed point F will intersect the bottom product specification

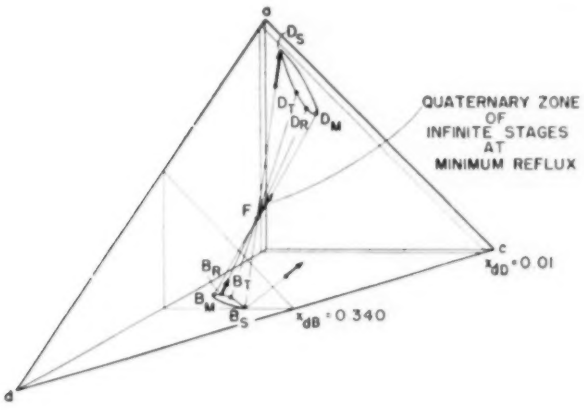


FIG. 5

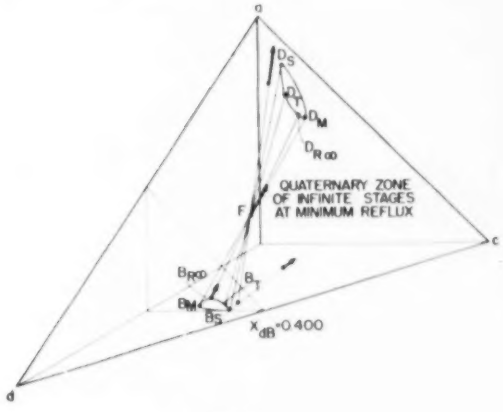


FIG. 6

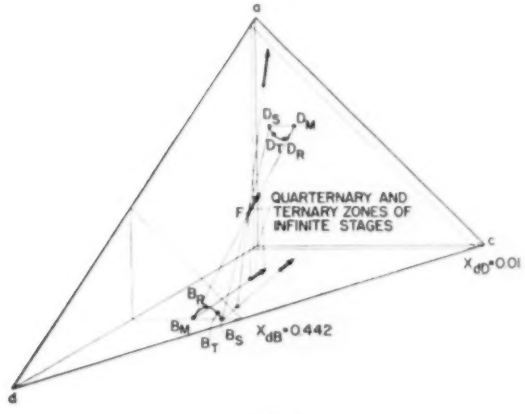


FIG. 7

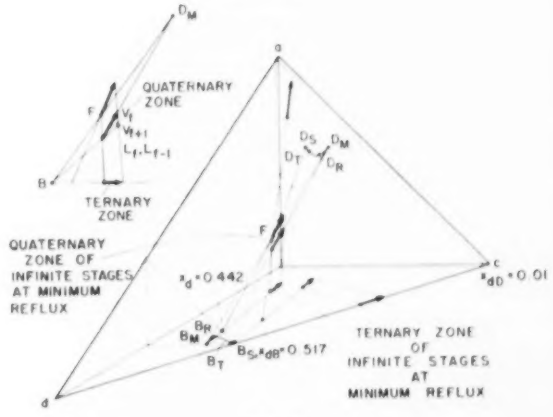


FIG. 8

plane. When x_{dB}=0.340, the intersection occurs at x_a=0 so that the reboiled stripping column contains two zones of constant composition, a quaternary zone at the top of the column and a ternary zone in the middle of the column, fractionation between the zone being similar to that shown in Fig. 6, Art. 3.[3] The composition in the ternary zone of infinite stages is calculated from the equation

$$x_s = \frac{(L/V-1)\ x_{sB}}{(L/V-\alpha_s K_r)} = 1.0 \qquad (10)$$

Using the value of L/V as determined from the line $DLFB_s$; L/V=BD/BL=0.9254/0.8645=1.07. The results are shown below. Extrapolation of the tie line in the ternary zone of infinite stages to x_s=0 represented by the point B in Fig. 1 is also listed below.

Ternary Zone of Infinite Stages—Refluxed Stripping Column

Component	Bottom Product Comp., B_s in Figure 1	Ternary Zone Liquid in x	Ternary Zone Vapor in y	B'_s
a	0.000	0.000	0.000	0.000
b	0.325	0.9042	0.9421	0.000
c	0.335	0.0588	0.0408	0.483
d	0.340	0.0370	0.0171	0.517

When the concentration of component *d* in the bottom product is greater than 0.3400, the bottom product can no longer be made in a refluxed stripping column. However, the bottom products along the extrapolation of the tie line in the ternary zone of infinite stages $B_s'B_sLV$ in Fig. 1 can be made in columns having the same ternary zone as shown in Fig. 1 in the middle of the stripping section and a rectifying section of finite stages as shown in Fig. 2. The path of fractionation from the bottom product up to the feed stage is similar to that of Fig. 7, Art. 3.[3]

The construction of the diagram at the feed stage, in Fig. 2, is similar to that of Fig. 12, Art. 6[4] for ternary systems (Intermediate Reflux Path) and must be located by a trial and error assumption of the location of L_f. Both V_f representing the vapor leaving the feed stage and V_f+1 representing the vapor entering the feed stage lie on the vapor line from the ternary zone of infinite stages, the point representing $(F+L_{f-1})$ must lie on the liquid line from the ternary zone since $(F+L_{f-1})-L_f=(V_f+1-V_f)$ and the lines $Vf+1\ Vf$ and $Lf\ (F+L_{f-1})$ must be parallel. Thus the point representing the sum of the feed, F, and the liquid entering the feed stage, L_{f-1}, is determined by the intersection of the line B_sV_f with the liquid line from the ternary zone of infinite stages. The point representing the liquid entering the feed stage L_{f-1} is then located by the intersection of the lines D_sV_f with the line $F(F+L_{f-1})$. When the point, L_f, has been correctly assumed, a stage to stage calculation up the column using the L/V vaue in the rectifying section will terminate at D_s. Note that stage to stage calculations down the column, from any point L_f on the liquid line from the ternary zone of infinite stages will terminate in the ternary zone.

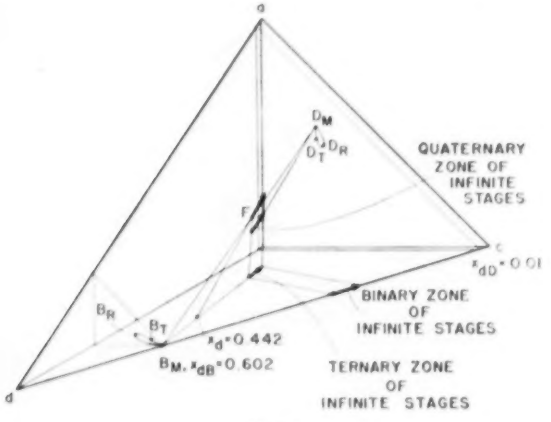


FIG. 9

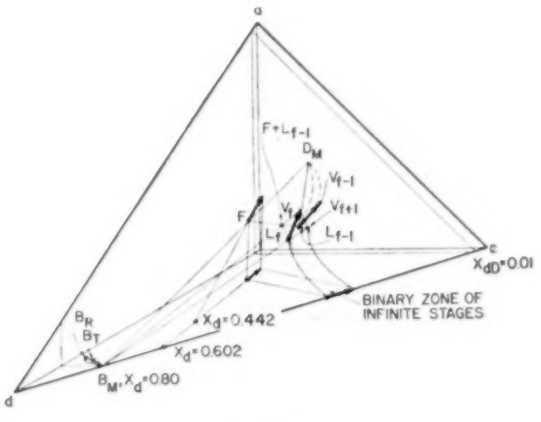


FIG. 10

The value of L/V in the stripping section for any value of x_{dB} for this case is readily calculated by taking the proportional segment along the extrapolated ternary zone tie line. For example, if $x_{dB} = 0.40$

$$L/V = B_s V_\infty / B_s L_\infty = \frac{0.40 - 0.0171}{0.40 - 0.0370} = 1.055$$

When $x_{dB} = 0.517$ the bottom product is a binary mixture and the column has both binary and ternary zones of infinite stages in the stripping section as shown in Fig. 3. When $x_{dB} > 0.517$, the column has only one zone of infinite stages in the stripping section as shown in Fig. 4. Note in Fig. 4 that the lines V_f, $V_f + 1$ and $(F + L_{f-1})$ L_f must be parallel.

Minimum Reflux

When the equilibrium tie line originating at the feed point F, intersects both specification planes, the minimum reflux ratio is established by the quaternary zone of infinite stages at the feed stage. In the present example, since the feed tie line intersects $x_a = 0$, at $x_{dB} = 0.442$, the quaternary zone limits the reflux ratio over the range of specifications $x_{dB} = 0.25$ to $x_{dB} = 0.442$. The minimum reflux condition and the range of product variation for $x_{dB} = 0.340$ is illustrated in Fig. 5. A similar diagram for $x_{dB} = 0.04$ is shown in Fig. 6, where the point B_s represents the bottom product from a column having an infinite number of stages in the stripping section. When $x_{dB} = 0.442$, a ternary zone of infinite stages develops with the quaternary zone as shown in Fig. 7. Also included in Fig. 7 are the bottom products at total reflux, from the infinite stage rectifying column and from the column having an infinite number of stages in the stripping section.

The bottom products between B_s and B_M ($x_{aB} = 0.0$) in Fig. 7 are made in columns having an infinite number of stripping stages by a fractionation path similar to that shown in Fig. 2. However, in this case, ternary zone of infinite stages must be located by trial and error, i.e. by assuming L/V, calculating the ternary zone by Equation 10 until it is impossible to connect the path to the distilate obtained by a material balance.

At a bottom product specification of $x_{dB} > 0.442$ such as $x_{dB} = 0.517$ as shown in Fig. 8, the minimum reflux is established at the product along the extrapolation of the ternary zone tie line B_M and a quaternary zone of infinite stages adjacent to the feed stage also occurs similar to the ternary separation discussed in Art. 6, Fig. 11.[4] At $x_{dB} = 0.517$ the bottom product from a column having infinite stripping stages may be a binary mixture as shown in Fig. 3.

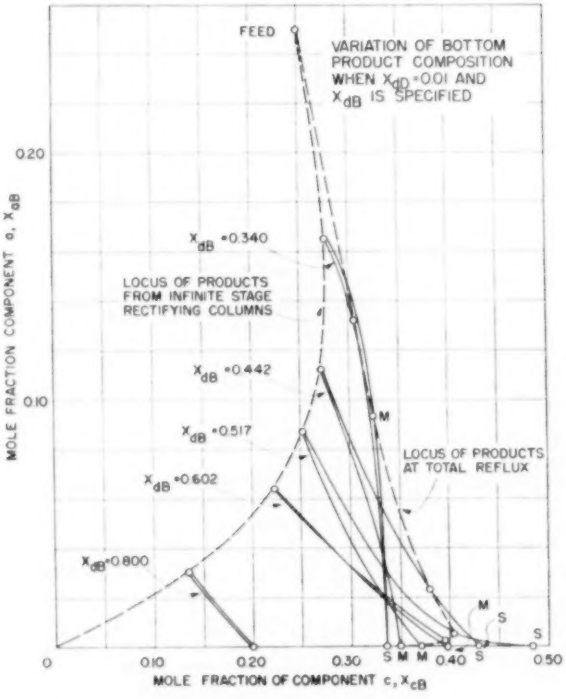


FIG. 11

At a bottom product specification of $x_{dB} = 0.602$ or more the only way the separation can be achieved in a column having infinite stripping stages is at minimum reflux as shown in Fig. 9 and 10, the bottom product being a binary mixture.

The composition envelopes obtained from Figs. 1—10 for the bottom products at various separations are shown in Fig. 11.

References

(1) White, R. R., Petroleum Processing, 8, 1336 (1953).
(2) White, R. R., Petroleum Processing, 8, 1026 (1953).
(3) White, R. R., Petroleum Processing, 8, 706 (1953).
(4) White, R. R., Petroleum Processing, 8, 1174 (1953).

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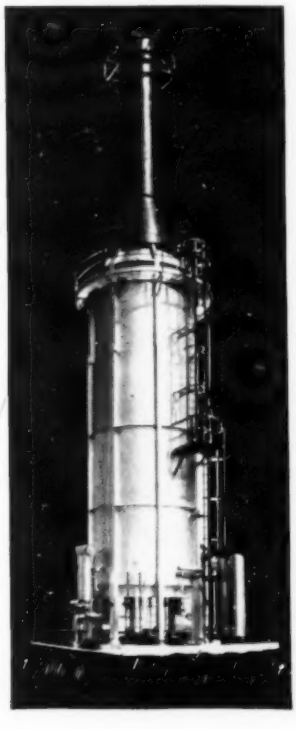

The Isoflow Heater basically is a circular steel shell; this results in an explosion-resistant structure. The shell is lined on the inside with insulation and insulating refractories; this results in a wall with a zero air leakage and high efficiency. The vertical tubes are combined with integral convection tubes; this results in less headers in the heaters for complete cleanability. The integral radiant convection tubes and minimum number of headers result in a minimum pressure drop for a given velocity. The vertical tubes completely shield the walls resulting in low wall maintenance. The small number of headers in combination with the vertical tubes result in ease of cleaning and, if desirable, gang-cleaning of several tubes simultaneously. Individual burners, symmetrically spaced with relationship to the tubes, results in even heat distribution horizontally. The reradiant cone effects even heat distribution vertically. Segregated burners result in ease of firing and inspection of burners. These are some of the design features which place Isoflow Furnaces in a class of their own

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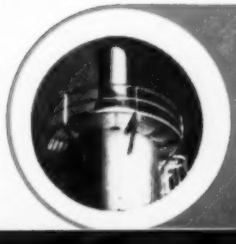

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Petrochemical Processing Section

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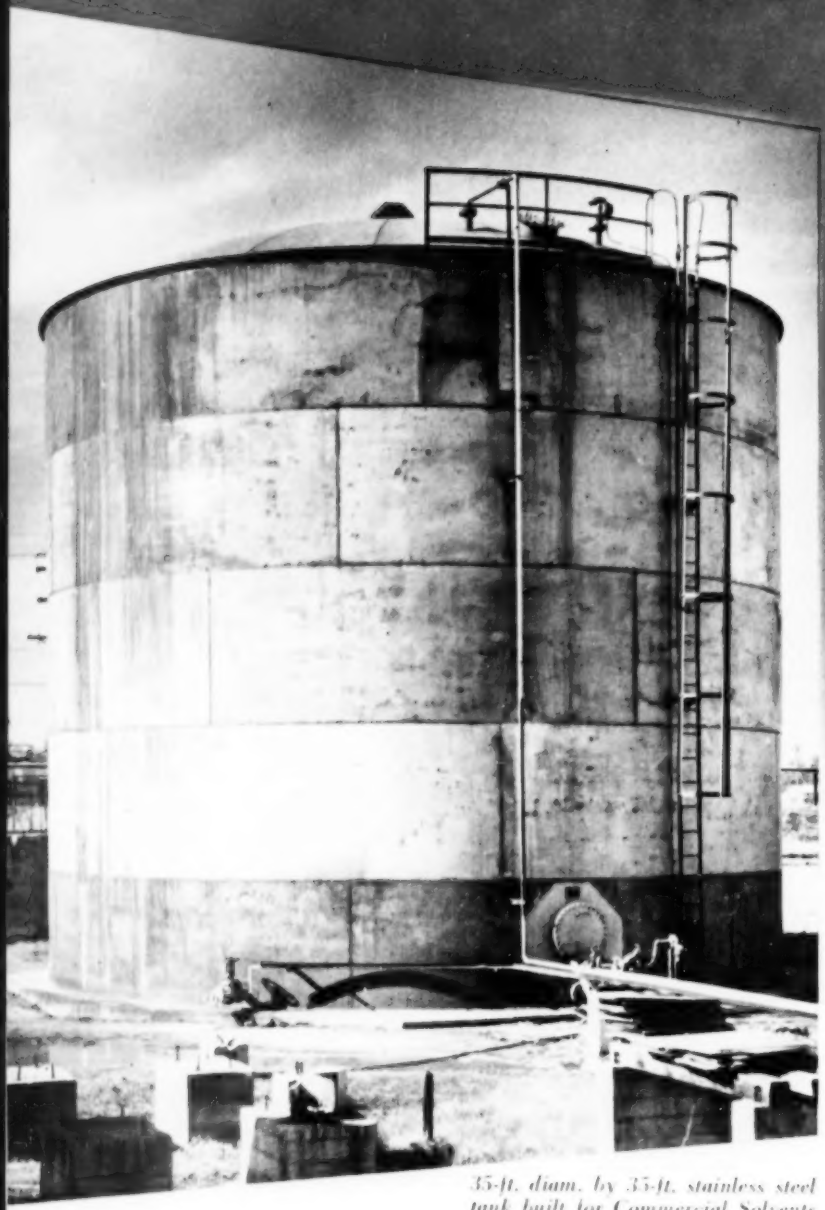

35-ft. diam. by 35-ft. stainless steel tank built for Commercial Solvents Corporation at Sterlington, La.

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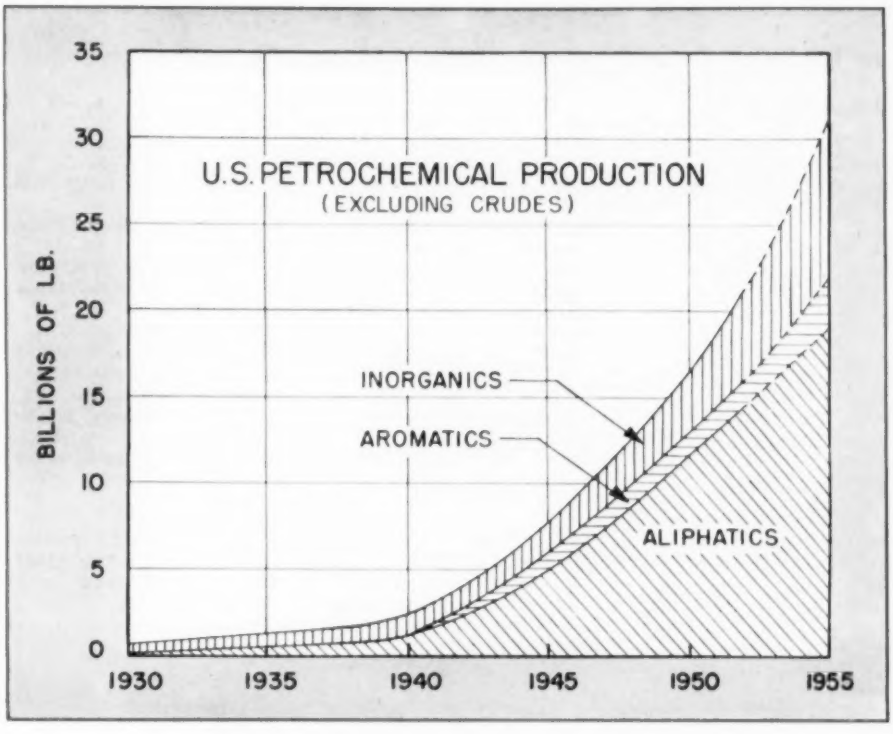


SHARP UPSWING in postwar petrochemical manufacturing is illustrated in production chart (left)

Petrochemicals in the Postwar Years

ACS symposium covers recent developments, future growth, raw materials outlook

A STAFF REPORT
by the Editors of
Petroleum Processing

TOTAL petrochemical production is expected to reach a volume of 31.5 billion pounds annually in 1955, according to R. L. Bateman, manager of the Fine Chemicals Dept., Carbide and Carbon Chemicals Co.

Bateman made this prediction at a symposium on "Petrochemicals in the Postwar Years" sponsored by the American Chemical Society's Division of Petroleum Chemistry during the annual ACS meeting in Chicago, Sept. 6-11. Co-author with Bateman was J. A. Field, asst. mgr. in the same department.

"Statistics on petrochemicals are tricky," Bateman explained. "The same atoms can be easily counted two, three or four times in progressing from crude starting materials to the final end products. Therefore, it is necessary to keep in mind the distinctions between crudes, intermediates and finished products. By Tariff Commission definitions, benzene and ethylene are crudes; aniline and ethanol, intermediates; and dyestuffs and cellulose acetate, finished products." His figures were confined largely to intermediates.

"For the year 1952," Bateman stated, "petrochemicals comprised 21% of the U.S. chemical production. This amounted to 21.4 billion pounds of the entire production of 100.4 billion pounds. The value of petrochemicals was $2.7 billion out of a total of $5.4 billion.

"The petrochemical portion is made up of $2.2 billion of aliphatics, $0.3 billion of aromatics, and $0.2 billion of petrochemical inorganics. The average sales price per pound of the aliphatics was 15¢; of aromatics, 19¢; and of the inorganics, 2.5¢. Total 1952 assets of the petrochemical industry of $2.5 billion were about 52% of the entire chemical industry."

Looking to the next few years, Bateman predicted that "total petrochemicals production in 1955 should rise to 31.5 billion pounds. A break-

Table 1—New Tank-Car Petrochemicals Since 1945 and Their Uses

Family and Product	Uses
Hydroxy Compounds	
Butyl Ethyl Propanediol	insect repellant, including use in an insect repellant formulation for clothing impregnation.
Diisobutyl Carbinol	large volume use as a special reaction medium; limited application in printing inks and lube oil additives.
Iso-octyl Alcohol	esters, such as phthalate and adipate, for use as plasticizers for vinyl resins; its low-volatile ester of 2,4-D acid has found extensive use as a weedkiller.
Methoxy Polyethylene Glycols	available in three molecular weights (350, 550, 750) as "Carbowax;" their fatty acid esters exhibit good emulsifying, dispersing and wetting properties for aqueous processes in the textile and leather industries; useful alone in certain ore flotation processes.
Propylene Glycol Alkyl Ethers	lacquer solvents, hydraulic fluid components, agricultural emulsifiers and couplers.
Nonyl Phenol	reacted with ethylene oxide to yield non-ionic surface-active agents and detergents.
Aldehydes and Ketones:	
Acrolein	starting material for methionine; can be substituted for glycerol in Skraup synthesis for quinone and substituted quinolines; used in production of alpha-hydroxyadipaldehyde, an insolubilizing agent for protein and cellulosic materials.
Diisobutyl Ketone	high-boiling lacquer solvent.
Pyruvic Aldehyde	intermediate in synthesis of insecticide allethrin.
Trioxane	
Ethylhexaldehyde	
Halogenated Compounds:	
Chlor IPC	N (p-chlorphenyl) isopropyl carbamate, pre-emergence weed killer.
Chlordane	insecticide against chewing insects.
Aldrin	insecticide against chewing insects.
Sodium Dichlorphenoxyethyl Sulfate	pre-emergence weedkiller, under trade name "Crag" herbicide.
Dichlorbutene	
Dieldrin	insecticide against chewing insects.
Epichlorhydrin	
Acids and Anhydrites:	
Alkenyl Succinic Acids	inhibitors for special oils and lubricants.
Acrylic Acid	special textile size in polymer form; intermediate for soil conditioners.
2,4,5-Trichlorphenoxyacetic Acid	improvement over 2,4-D, offering added advantage of effectively controlling woody plants, such as mesquite.
Peracetic Acid	textile bleach.

down of this total indicates that aliphatics will represent 19.4 billion pounds; aromatics, 3 billion pounds; and inorganics, 9.1 billion pounds. . . . By 1955 the petrochemical industry will occupy even a larger proportion of the chemical industry that it now does and by that time should have $4 billion invested in plants producing petrochemicals with a value of $4 billion."

In reviewing developments in recent years which are influencing this rapid growth, Bateman listed 46 new petrochemicals which have grown to tank-car stature in the post-war period. These new "tank-car" petrochemicals and their uses are tabulated in Table 1, compiled by PETROLEUM PROCESSING from data presented by Bateman.

A study of the applications shows that 40 of these 46 chemicals grew to their present status by finding markets in six major fields—agriculture, plastics, synthetic fibers, specialty rubbers, drugs and detergents, as tabulated in Table 2.

Opening talk at the symposium was a paper prepared by Eugene Ayres of Gulf Research and Development Co. on "Raw Materials for Organic Chemicals."

Table 2—End-Use Application of New Tank-Car Petrochemicals Since 1945

	End-Use Application					
Family	Agriculture	Plastics	Fibers	Rubbers	Drugs	Detergents
Hydroxy	1	1	2	—	—	1
Acids	1	—	3	—	—	—
Esters	3	7	—	1	1	—
Aldehydes	3	—	—	—	1	—
Halogenated	4	—	1	—	—	—
Amines	3	—	2	1	2	—
Hydrocarbons	—	—	—	—	—	2
Totals	15	8	8	2	4	3

Ayres observed that organic chemicals have always been derived from carbonaceous fuels and that "petroleum hydrocarbons have become important sources of chemicals because they have been abundant and cheap. . . . Continued acceleration of the rate of growth of the petrochemical industry will be dependent upon cost, which is, in turn, dependent upon relative abundance and the nature of fuel preparation processes."

He then went on to give a few general observations on the several types of combustibles which are or could be sources of organic chemicals and their future availability, which are summarized below:

1) The present marked trend away from vegetation as a source of chemi-

Table 1 (Cont'd)—New Tank-Car Petrochemicals Since 1945 and Their Uses

Family and Product	Uses
Acids and Anhydrites (Con't):	
Terephthalic Acid	polyethylene terephthalates are being marketed as Dacron synthetic fiber, Mylar film, and photographic film.
Esters and Ethers:	
Allethrin	insecticide, as a substitute for pyrethrum.
Diallyl Phthalate	low pressure laminating resins.
Dibutyl "Carbitol"	
Diglycol Dibensoate	
Ethyl and Methyl Acrylates	
Ethyl Ethoxypropionate	
Maleic Alkyl Esters	monomers for vinyl type resins, intermediates for surface-active agents of the sulfosuccinate type, and for the new insecticide Malathon.
Octyl Adipate	low-temperature plasticizers for vinyl resins (as ethylhexyl or isooctyl adipates).
Octyl Phosphate	low-temperature plasticizer for vinyl resins (as ethylhexyl phosphate).
Octyl Hexahydrophthalate	general-purpose plasticizer (as ethylhexyl hexahydrophthalate), particularly well-suited for organosol and plastisol dispersions.
Vinyl Alkyl Ethers	Polymers are used in pressure-sensitive adhesives, and are of interest as viscosity index improvers and pour point depressants for special lubricating and hydraulic oils.
Parathion	
Dimethyl Carbate	insect repellant for skin application.
Amines:	
Dimethyl Formamide	nylon spinning solvent.
Heptadecyl Glyoxalidine	"Crag" fruit fungicide 341, particularly effective against apple scab and cherry leaf spot.
Methyl Ethyl Pyridine	manufacture of niacin, a part of the vitamin B complex.
N-Butyl Acetanilide	ingredient of insect repellant mixture for clothing impregnation.
gamma-Picoline	starting point for TB drug, isonicotinic hydrazide.
alpha-Picoline	monomers for 2-vinyl pyridine, with potential uses in special synthetic rubber latices as a pre-dip for nylon cords.
SR 406	fungicide (now called Captan 406).
Methyl Vinyl Pyridine	used in acrylonitrile fibers to enhance dyeing properties; monomer with potential uses in special synthetic rubber latices as a pre-dip for nylon cords.
Hydrocarbons:	
Alkylated Aromatics	synthetic detergents.
Dodecyl Benzene	synthetic detergents.

cals will continue for at least the balance of the century. Chemicals from vegetation will be largely those for which by-products from food production offer unique chemical opportunities.

2) Chemicals from dry natural gas will contract rather than expand. This estimate is based on the assumption that gas will become increasingly relatively expensive, and will not be preferred to some other fuels as a chemical raw material.

3) Synthetic gas will be largely by-product in character. Most of it will be of low Btu value and suitable only for local use.

4) Fischer-Tropsch conversion of coal will begin to supply substantial amounts of ethylene and other aliphatics before 1970, but production of motor fuel by this process will be minor.

5) Rather large production of coal chemicals will be developed during the next 10 years from coal hydrogenation carried out for the specific purpose of making chemicals, but coal hydrogenation will not be on a sufficiently large scale to provide substantial amounts of LPG as a starting point for aliphatics.

6) Aromatics production from petroleum will decline. About 5% of present petrochemicals are aromatics, but extended production of typical coal-chemicals from petroleum is almost certain to be too wasteful and costly to compete on a major scale with production from coal.

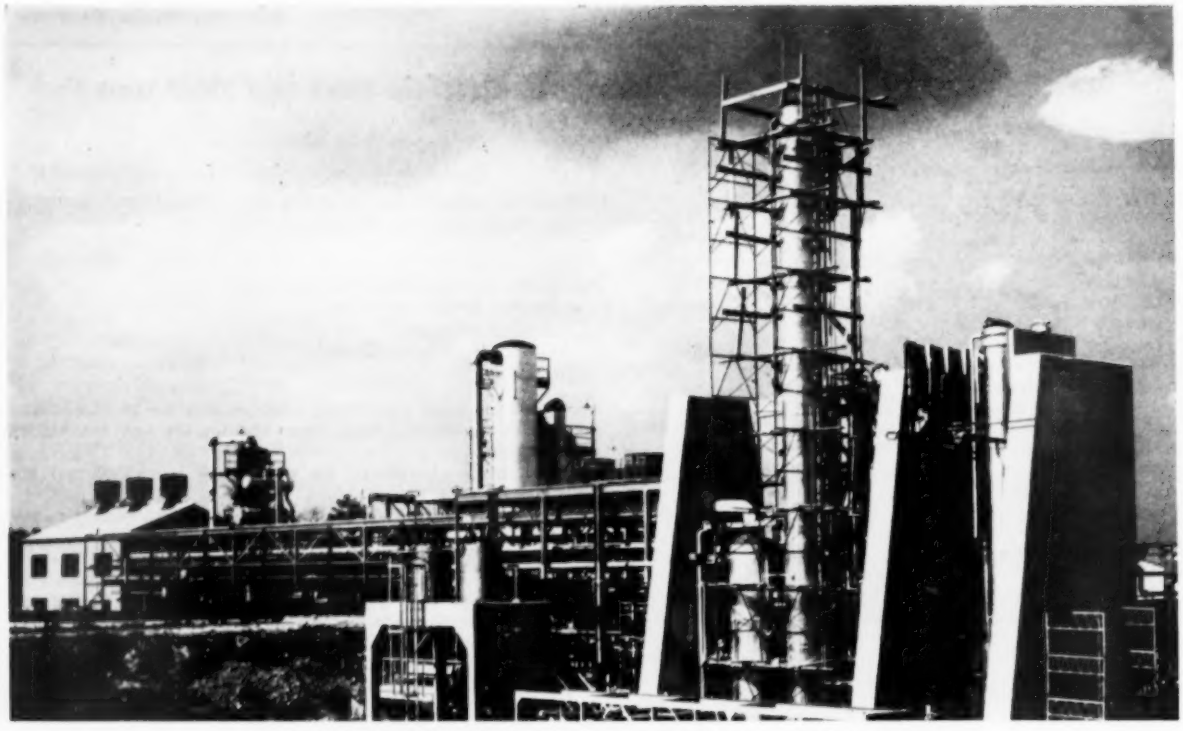
7) Low-temperature carbonization of coal will be practiced on a large scale with production of abundant gas, but that gas is not likely to be economically attractive as a starting point for chemicals. However, the major part of some of the coal-chemicals may come from low-temperature tar.

8) Oil shale will not be important as a by-product source of present tonage organics (either aliphatic or aromatic), but may become extremely important in fields not yet explored or developed.

9) Ethane associated with natural gasoline manufacture will become increasingly important for petrochemicals, and in the long run should be cheaper than propane or butane for ethylene manufacture.

10) LPG will continue to be available, at least until 1970, in sufficient quantity and at low enough cost to satisfy all chemical demands for propylene, isobutane, isobutylene and ethylene.

11) Economically recoverable ethylene in refinery gas will be insufficient to satisfy demand, but increasing yields of ethylene can be expected from additional conversion of refinery gas ethane.



A WAR BABY COMES OF AGE in this first large-scale plant manufacturing . . .

Hydrazine at Lake Charles

Rocket fuel to insecticides—a wide market ahead for this chemical building block

By D. P. THORNTON, Jr.
Southwestern Editor

THE first large-scale commercial hydrazine plant in the U. S. has been completed by Mathieson Chemical Corp. as a part of its chemical manufacturing facilities at Lake Charles, La.

The new plant, the result of Army-sponsored research at Mathieson's Niagara Falls, N. Y. laboratories, is being operated by the recently formed Matholin Corp. This company is equally owned by Mathieson and Olin Industries, Inc., the latter being a large manufacturer of firearms, explosives and diversified chemicals.

To manufacture hydrazine, known since late in World War II for its value as a propellant in rockets, Mathieson will use a modification of the F. Raschig synthesis developed in 1907 which reacts (oxidizes) ammonia with sodium hypochlorite (NaOCl bleaching powder) to form hydrazine, water and sodium chloride. Unsuccessful attempts have been made to find a better synthesis, including photochemical and electric discharge methods as well as straight chemical synthesis, but none have shown significant advantages over the Raschig route, which was slow, gave poor yields and was difficult to control.

For military reasons, Mathieson's improvements on the process are classified, but they have made important advancements in controllability and reaction yields. Other contributions are methods to produce the anhydrous material. The Germans in World War II were never able to go beyond the hydrate form, which contains approximately 64% hydrazine and the balance water. Neither were the Nazis ever able to bring their two plants to full production before the war ended.

Mathieson follows the synthesis, which produces a low concentration of hydrazine in brine, with salt separation and distillation to produce a monohydrate containing 64% hydrazine. To produce the anhydrous material, their research has produced two feasible methods. The method of choice is azeotropic distillation, while the other involves ammoniolysis of the hydrate. Presumably the azeotropic method will be followed at Lake Charles.

Initially, the plant will produce hydrazine hydrate, anhydrous hydrazine, monohydrazine sulfate, dihydrazine sulfate, hydrazine hydrobromide and hydrazine hydrochloride. Other derivatives will be produced as demand develops.

Military requirements are expected to take most of the plants initial output. Indications are that non-military uses of hydrazine will develop further in the near future and Mathieson expects them to become significant in terms of total demand.

Pure anhydrous hydrazine is a clear, colorless liquid closely resembling water in density and boiling point. Similarity ceases here, however, since it is a powerful source of chemical energy and one of the most reactive inorganic compounds known. In chemical symbolism hydrazine is written $H_2N{=}NH_2$ to show it contains two nitrogen atoms bonded to one another and each holding two hydrogens. It is a close relative of ammonia, from which it is commercially derived.

The four hydrogens of hydrazine are readily replaced by other atoms and chemical radicals to produce de-

rivatives having an extremely wide range of molecular combinations and chemical properties. It is not so easy to disrupt the nitrogen-to-nitrogen bonds, however, and any reaction vigorous enough to do so necessarily releases a large amount of energy. This energy release, as heat, explains the military interest in hydrazine as a rocket fuel following disclosure that the Germans were using it in their World War II rockets.

Even though the nitrogen bonds can be ruptured with explosive violence, hydrazine is not considered a dangerous chemical when properly handled, any more so than gasoline, for example. The compound is insensitive to shock or impact and friction. It is shipped commercially by truck or rail in stainless steel drums under a nitrogen atmosphere. It will burn with a blue flame like alcohol when ignited.

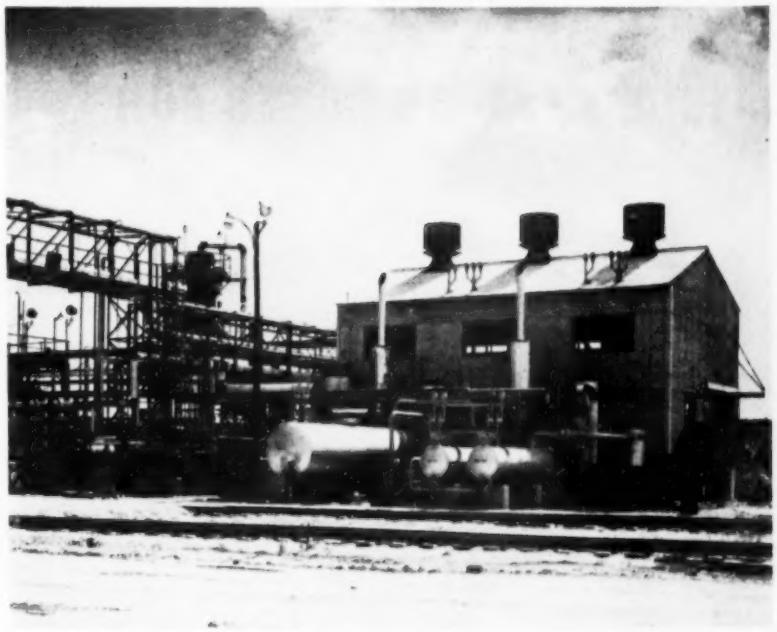
Before World War II hydrazine was a laboratory curiosity. When first sold from experimental production in the U. S., the price was $50 per lb. By 1949, when pilot plant quantities initially became available, the price dropped to $9 per lb. Today, a pound costs $2.50 on a hydrazine content basis for the aqueous solution of the hydrate. Mathieson officials believe that with further process improvements, the price tag may ultimately be marked down to approximately 50¢ per lb.

While it is classified as an inorganic compound, hydrazine also may be classified as a petrochemical, in that the ammonia from which it will be derived at Lake Charles comes partly from hydrogen resulting from the decomposition of natural gas. The balance of the hydrogen used in ammonia synthesis will be secured from a nearby alkali plant as a by-product from electrolysis of brines.

Aside from its military uses, the compound shows great promise as a raw material in preparing agricultural chemicals, dyestuffs, detergents, textile coatings, plastics modifiers, foaming agents (synthetic rubber and plastic fillers), fine chemicals, drugs and explosives. Over 2000 derivatives of the basic compound have been reported while several score more are under laboratory investigation. Many of these will use petroleum-derived raw materials in their synthesis.

Although it was rocket fuels which brought hydrazine out of obscurity, its chemical reactivity probably augurs more for a bright future than military uses in rocketry.

Some of the most interesting uses of hydrazine derivatives are in agriculture. Maleic hydrazide has shown startling properties as a growth retardant for grass and other plants. Testing for several seasons on grass plots along state highways in New York and Connecticut, the material has reduced mowings per season from 19 to two. Applied in solution as a spray, it stops sprouting of onions, potatoes and carrots during winter storage. It is being used to prevent the flowering of tobacco, to produce male sterility in hybrid corn and to prevent opening of buds on fruit trees until danger of frost is past.



REFRIGERATION, AMMONIA RECOVERY units (right), synthesis area (left)

Other hydrazine derivatives are serving successfully as insecticides and fungicides. One of them will kill mites without poisoning birds which feed on the dead mites; the first time such a material has been available.

Hydrazine and its derivatives show promise in the industrial field as starting materials for new nitrogen-ring dyes, synthetic detergents, wrinkle-resistant coatings for textiles, and as modifiers of synthetic fibers and plastics.

Another very important industrial property is hydrazine's strong reducing action. As a reducing agent it is used to separate rare metals in the pure state from their oxides or salts, to plate thin coatings of metals on glass, plastics and other non-conducting materials, and to remove final traces of dissolved oxygen from boiler water which otherwise might give rise to corrosion problems.

Hydrazine hydrobromide has been put to work as a soldering flux for copper and brass because of its reducing action. The flux encourages formation of a good soldering bond but leaves no corrosive residue on the metal. Superior fluxes also have been developed for the difficult problem of soldering aluminum.

Derivatives of hydrazine are showing promise in the drug field in the treatment of such varied diseases as tuberculosis, high blood pressure and urinary tract infections. It already is being employed on a limited scale in the preparation of hormones, antihistamines, antibiotics and certain vitamins and sulfa drugs.

In rocketry and explosives, hydrazine's big advantage comes from its high energy release, especially when in the anhydrous form. Elimination of the dead weight represented by 36% water is not the only principal advantage, for it eliminates also the dissipation of part of the heat energy produced in vaporizing the water. It is known that the Germans were using it experimentally also in torpedoes and the trackless propulsion of submarines under water at high speeds.

Some experts today contend that a mixture of hydrazine and nitric acid will be the most likely fuel for a superrocket. During World War II hydrazine was made in the U. S. in limited quantity for experimental purposes and as a raw material in manufacturing azides for shell detonators.

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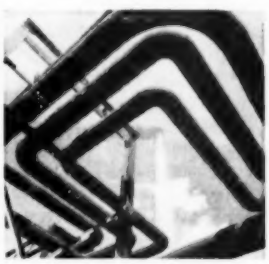

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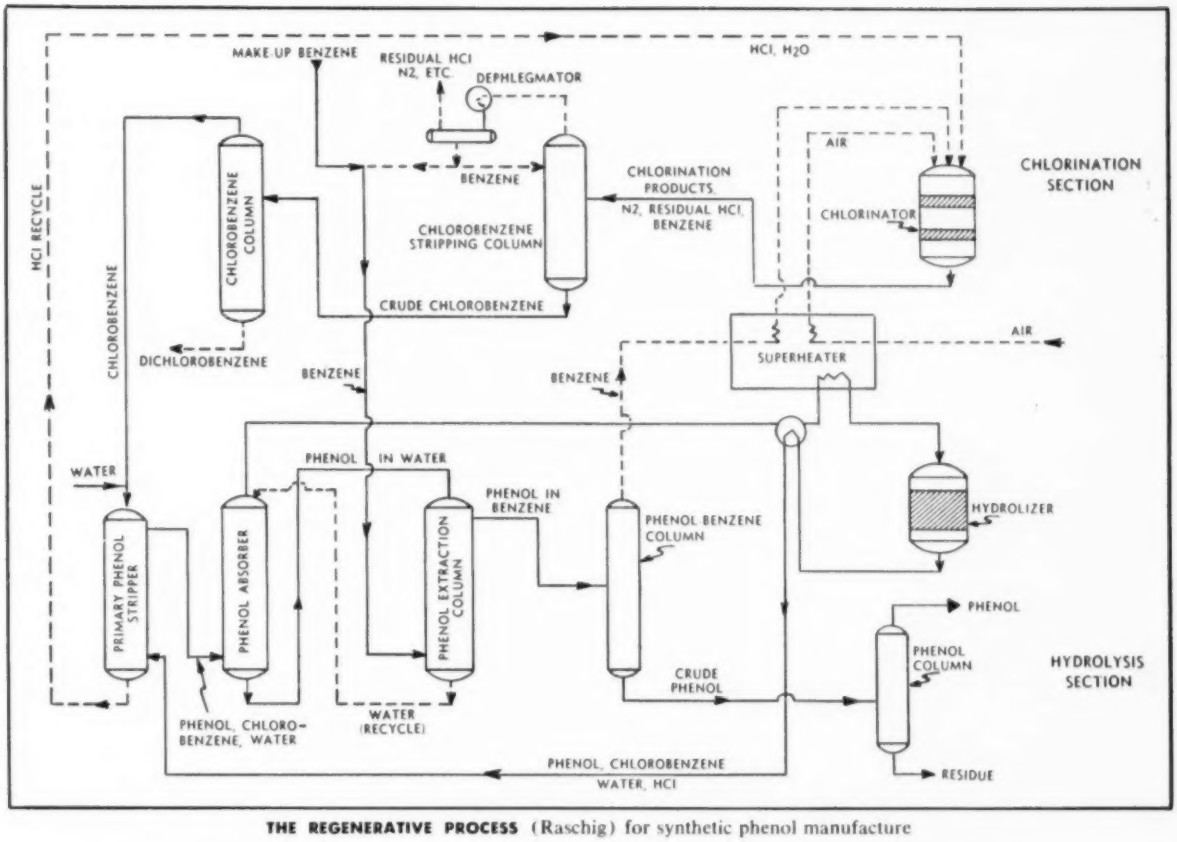

THE REGENERATIVE PROCESS (Raschig) for synthetic phenol manufacture

Synthetic Phenol Manufacture

its sources, its markets, and the four major processes—cumene hydroperoxide, Raschig, sulfonation, chlorination

Part 2—The regenerative (Raschig) process

By PETER W. SHERWOOD
Chemical Engineer, New York

MANUFACTURE of phenol by the regenerative (Raschig) process is practiced in the United States by Durez Plastics and Chemicals, Inc., at North Tonawanda, N. Y. A smaller installation, following the same scheme, is operated by Dr. G. F. Raschig, G.m.b.H. at Ludwigshafen, Germany.

The synthesis of phenol by this route involves two chemical steps: Chlorination of benzene by hydrogen chloride in the presence of air, followed by steam hydrolysis of monochlorobenzene. Hydrogen chloride evolved in the second stage is recovered and recycled to the chlorination stage.

$$C_6H_6 + HCl + \tfrac{1}{2}O_2 \longrightarrow C_6H_5Cl + \tfrac{1}{2}H_2O \quad \ldots (2a)$$

$$C_6H_5Cl + H_2O \longrightarrow C_6H_5OH + HCl \quad \ldots (2b)$$

Except for losses in the process, benzene is the only required raw material.

(a) Production of Monochlorobenzene: Hydrogen chloride as such is not capable of effecting the chlorination of benzene. It is, however, possible to oxidize HCl to chlorine and water in accordance with the Deacon process at temperatures above 400° C and in the presence of copper chloride.

At the conditions of the Deacon process, benzene oxidation reaches excessive rates. The important contribution of the Raschig process is the development of a catalyst which promotes the chlorination of benzene by means of HCl and air at low temperatures (220-270° C).

The catalyst consists of the oxides

of aluminum, copper, and iron when charged to the reactor. In preparing the catalyst, a concentrated sodium aluminate solution is treated with a solution of copper chloride and ferric chloride in aqueous HCl. The precipitate is carefully washed, dried, and pelleted.

If HCl and air are passed over this catalyst at reaction conditions, the formation of free chlorine is practically nil. Nevertheless, the system is capable of chlorinating benzene in good conversion. The reaction probably takes place in two steps:

$$Cu_2Cl_2 + \tfrac{1}{2}O_2 + 2HCl \longrightarrow 2CuCl_2 + H_2O \ldots (3a)$$

$$C_6H_6 + 2CuCl_2 \longrightarrow C_6H_5Cl + Cu_2Cl_2 + HCl \quad (3b)$$

The overall reaction is strongly exothermic and suitable cooling must be provided to prevent the attainment of temperatures at which yield losses due to benzene oxidation become serious.

HCl utilization is strongly affected by operating temperature and by space velocity. It rises precipitately as the temperature is raised above 220° C and realizes an optimum in the range 250-270° C. A rate of chlorobenzene formation in the range of 4.6 lbs./cu.ft./hr. is found to be the optimum throughput from the point of view of HCl utilization.

In practice, about 98% of the HCl fed to the reactors is converted. Only some 0.2% of the benzene is lost by oxidation reactions under such conditions.

Mathes[13] reports that the process is economically feasible at a per-pass conversion of 7% (based on benzene). However, much higher conversions—up to 50%—can be attained. As the extent of per-pass conversion is raised, an increasing amount of chlorobenzene is converted to polychlorinated homologues in accordance with the dictates of the mass law. Most of the by-product so formed is dichlorobenzene (about 70% para- and 30% ortho-isomer). Ability to market these derivatives is influential in determining the degree of conversion taken per pass. The effect of conversion on the formation of mono- and dichlorobenzene is illustrated in the following table:

	Product Formation	
Conversion	*Monochloro-Benzene*	*Dichlorobenzene*
5.25%	5%	0.25%
11.00	10	1.0
24.00	20	4.0

At Durez' phenol plant, the chlorination is carried out in cellular steel chambers in which alternate cells are packed with catalyst.[14] Air is circulated to provide cooling for the exothermic reaction and thus prevent temperatures in excess of 250° C.

Part 1 of this series, dealing with the sources and markets for synthetic phenol, and describing the cumene hydroperoxide route to its manufacture, appeared in the September issue of PETROLEUM PROCESSING, *page 1348.*

The reactants are preheated independently and fed to the reactor at a mix temperature of 210° C. Following conversion, the effluent gases are cooled and condensed. The liquid product is crudely fractionated in an acid brick-lined column. The water-benzene azeotrope is taken overhead. The bottoms contains benzene and chlorobenzene in approximately equal proportions, together with some dichlorobenzene. After neutralization, the components are separated by fractional distillation.

At the plant of Dr. Raschig, G.m.b.H., air and benzene are preheated independently to 270-300° C. Hydrochloric acid, received in 17% concentration from the recovery unit of the hydrolysis stage, is evaporated and mixed with the other reactants without intermediate superheating. 1000 lbs. benzene call for the admixture of 218 lbs. air and 305 lbs. 17% hydrochloric acid.

The combined feed enters the converter at its mix temperature of 200-210° C. The catalyst is carried inside air-cooled tubes and the exit temperature is maintined below 250° C. Conversion per pass is 10%.

The reaction products pass directly into an acid brick-lined, packed tower where they are cooled and largely condensed by refluxing benzene. Noncondensed gases are after-cooled to 20°C and are finally passed through activated charcoal for the recovery of residual benzene.

The tower bottoms contain about 50% benzene and 50% chlorobenzenes. The mixture is neutralized with caustic soda and is finally water-washed. Two fractionating towers in series serve to separate and purify the chlorobenzene product and recycle benzene. The recovered dichlorobenzenes are separated in a batch still.[15]

(b) Steam Hydrolysis of Chlorobenzene: In the Raschig process, monochlorobenzene is converted to phenol with concomitant regeneration of HCl, in accordance with equation (2b).

Tricalcium phosphate serves as catalyst, and is produced by precipitation in the course of mixing aqueout solutions of calcium chloride and ammonium phosphate. The precipitate is washed and air-dried at 500° C.

In operation, this catalyst becomes coated with a deactivating carbon deposit. It must therefore be regenerated after 3-4 hours on-stream by passing air over it. Care must be taken to maintain the temperature below 580° C during regeneration to prevent permanent damage to the catalyst. Several catalyst chambers are provided which must be alternated on-stream.

Hydrolysis temperature is in the range of 450-500° C. A super-heater serves to preheat the mixture of approximately equal parts chlorobenzene and steam to feed temperature. Per-pass conversion is between 15 and 8% with a resulting phenol yield of 85-95%. Increase in conversion above 15% results in rapidly rising yield loss. About 6-7 lbs. phenol are formed per hour per cu. ft. catalyst.

With so low a conversion per pass, it is evidently desirable to effect phenol recovery without condensing the entire chlorobenzene and water vapors. This consideration of thermal economy is of signal influence on the commercial competitiveness of the process. A suitable means to accomplish this requirement has been worked out for the Raschig process.

The vapors leaving the hydrolizer are cooled to 270° C in heat exchange with the incoming reactor feed. They then enter an acid brick-lined packed tower in which they are contacted with water at 90° C. The ratio of water to entering HCl is carefully controlled to obtain a constant-boiling mixture of these two components. The HCl-water azeotrope leaves the bottom of the tower in liquid form. A small amount of phenol leaves with this liquid phase and is extracted with benzene. The extract is combined with the main body of phenol extract referred to below.

Make-up HCl is introduced into the phenol-free muriatic acid and this phase is then recycled to the chlorination stage.

Sufficient monochlorobenzene is introduced together with hot water into the primary spray column to make up the quantity consumed in the hydrolisers. This stream joins the vapors leaving the top of the column which are substantially free of HCl and contain almost all of the phenol and chlorobenzene derived from the

hydrolysis reactors and make-up.

To remove phenol from this stream, the vapors are passed through a second packed column in which they are contacted with a large quantity of hot (98-100° C) water. The vapor leaving the top of this column is a mixture of monochlorobenzene and steam (together with very little phenol) which is returned to the hydrolisers.

Leaving the base of the secondary water scrubber is a 4-5% phenol solution which is extracted with benzene. The extract is joined by another phenol-benzene solution formed in the course of purifying muriatic acid (and referred to above). After distillative removal of benzene from the combined extracts, phenol enters a refining column while the solvent (benzene) passes to the chlorination stage.

Typical raw materials and utilities consumption for the production of 100 lbs. phenol by the Raschig process is as follows: 97 lbs. benzene, 24 lbs. 18° Bé muriatic acid, 1650 lbs. steam, 16 kwh, 180 gallons cooling water, 3.5-4.0 gals. fuel oil.

Since its first use in the United States (1940), the Raschig process has held its own in competition with the sulfonation and chlorination routes. Barring the development of major unforeseen markets for acetone, it may be expected that the long-range outlook for the Raschig process is also good in competition with the synthesis of phenol via cumene hydroperoxide.

(The concluding section of this article, outlining the sulfonation and chlorination methods of phenol production, will appear in next month's issue.)

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Do You Know These Words?

By B. H. WEIL
Manager, Information Services
Ethyl Corp. Res. & Engrg. Dept.
Detroit, Mich.

A regular department intended to help administrators and operating men alike keep abreast of technical names and processes in the petrochemical field.

Terephthalic Acid

Terephthalic Acid, pronounced "tehr-ehf-thahl-ick ass-id," is a petrochemical which today is of growing importance as one of the raw materials for the "miracle fiber" Dacron. A white, crystalline powder, it is insoluble in water and many common solvents, but soluble in alkalies. It has the formula $C_6H_4(COOH)_2$, and differs from the better known "phthalic acid" by being the *para* benzene dicarboxylic acid instead of the *ortho* acid; i.e., its acid groups are attached to carbon atoms on the benzene ring which are separated by two other carbon atoms, while the *ortho* acid's groups are attached to two adjacent carbon atoms.

Just as phthalic (acid) anhydride is today being prepared commercially in increasing quantities by the oxidation of *ortho*-xylene, so terephthalic acid is being derived from *para*-xylene by oxidation with chromic acid. Both syntheses have been stimulated considerably by the growing availability of xylenes produced (along with such other aromatic hydrocarbons as benzene and toluene) by the catalytic reforming of petroleum naphthas. Xylenes are also obtained commercially from their original source, coal tar.

Terephthalic acid may be used as a reagent for the alkali in wool, but it finds its chief use in the manufacture of polyesters, by reaction with glycols such as ethylene glycol. These polyesters are then extruded as films or fibers, both of which are meeting with growing acceptance. They are true petrochemicals, incidentially, since almost the entire production of glycols stems from petroleum-derived olefins.

Future increases in the production of terephthalic acid are anticipated, and will almost certainly depend on the increased manufacture of *ortho*-xylene from petroleum. In turn, this is most likely, since catalytic reforming of naphthas is finding increasing favor, and it will be more profitable in many cases to separate the *ortho*-xylene instead of using it as a motor-fuel constituent.

Isobutyraldehyde

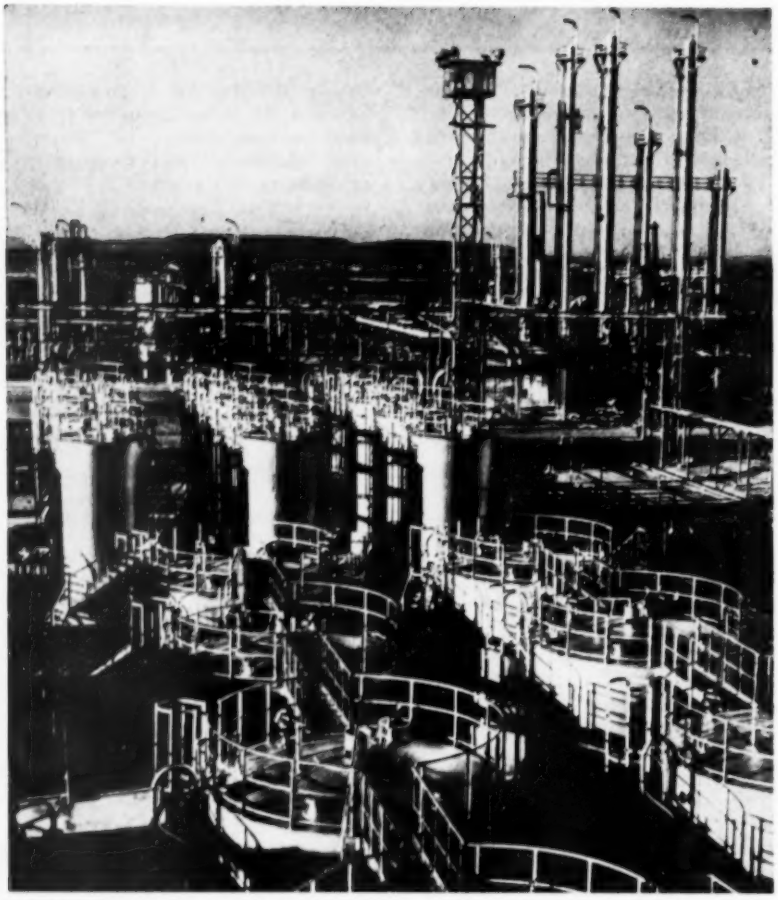
Isobutyraldehyde, also known as isobutyl aldehyde, is a petrochemical which only recently has come into commercial production. Pronounced "eye-so-beu-ter-al-dee-hide," and having the formula $(CH_3)_2CHCHO$, it is a chemically reactive, colorless liquid with a strong, pungent odor. It is soluble in most organic solvents, lighter than water, freezes at —85° F., and boils at 144-153° F.

Isobutyraldehyde may be prepared by the selective air oxidation of isobutyl alcohol, but currently it is manufactured commercially only by the oxo process. Here, this involves the reaction of propylene, carbon monoxide and hydrogen to give a mixture of n-butyraldehyde and isobutyraldehyde.

The principal commercial use for isobutyraldehyde, as such, is in the production of calcium pantothenate, a member of the water-soluble vitamin B group. Through oxidation, isobutyraldehyde may be converted to isobutyric acid, which is used in a petroleum sweetening process and to a limited extent in the preparation of isobutyrate esters, of interest as perfume and flavoring materials. Isobutyl alcohol is readily produced by the reduction of isobutyraldehyde and is gaining acceptance in its own right as a lacquer and industrial solvent. This alcohol also serves as a raw material for the manufacturer of a wide variety of isobutyl esters for various purposes. Isobutyl acetate is a promising lacquer solvent, and di-isobutyl phthalate is winning acceptance as a plasticizer for cellulose and vinyl plastics.

As mentioned earlier, the raw materials for isobutyraldehyde are propylene and a mixture of carbon monoxide and hydrogen, commonly referred to as "synthesis gas," Propylene is obtained commercially by separation from refinery gases or by the thermal cracking of propane, while the synthesis gas" may be obtained by the interaction of natural gas, carbon dioxide, and steam under the influence of heat, pressure, and suitable catalysts. At present, the only installation for the commercial manufacture of isobutyraldehyde is the plant of the Texas Eastman Co., located in the rich East Texas gas fields near Longview, Texas.

The excellent chemical reactivity of isobutyraldehyde and its availability in commercial quantities make it an interesting raw material for many new and valuable products.



DOLLAR SAVINGS FOR FRANCE are represented by this new Shell-Saint Gobain petrochemical plant, which will supply French industry annually with 16,000,000 lbs. of solvents previously imported from the U. S. A.

Shell's New Plant in France

Turns out 7,500 tons of propylene-based petrochemicals a year—mostly acetone

AN annual production of 7,500 tons of propylene-based petrochemicals will result from a new petrochemical plant put into operation early this year at Berre, France, by the Royal Dutch/Shell group.

Working closely in cooperation with Saint Gobain, a leading French manufacturer of chemicals and fertilizers, Shell has set up a joint enterprise—Shell-Saint Gobain. The new Berre petrochemical plant is a result of this venture, and was built at a cost of approximately $4-million. Its main product is acetone.

The plant is located next to the Shell Berre refinery, near Marseilles. Construction was started in July of 1951, and production began Dec. 1952. Official opening of the plant was Jan. 29, 1953.

Feedstock for the petrochemical operations consists of a propylene-propane mixture from the Shell Berre refinery. This stream is produced by thermal and catalytic cracking of Mid-Eastern crude, followed by purification in a Girbotol unit.

The plant proper consists of four distinct units, as follows:

a—acid reaction and residual gas treating.

b—isopropyl alcohol dehydrogenation.

c—acetone derivatives unit.

d—distillation section.

In the acid reaction section the liquid propylene-propane mixture is contacted counter-currently with concentrated sulfuric acid in a two-stage reaction system. A very high percentage of the propylene present in the feed is chemically linked to the sulphuric acid and leaves the reactor system as fat acid which, after progressive dilution and heating, hydrolyzes to give isopropyl alcohol and dilute spent acid.

The residual propane which is separated from the reaction mixture contains considerable amounts of acidic compounds. These are separated from the hydrocarbons and returned to the reaction mixture. The residual propane is purified to LPG specifications and returned to the refinery.

The dilute spent acid is concentrated by boiling off the water under vacuum in a continuous-type Mantius concentrator. A special feature of this concentrator is the use of tantalum heating elements, which give a six-fold increase of the heat-transfer coefficient over the previously used silicon-iron elements, which had the additional disadvantage of brittleness and little resistance against thermal shocks.

Part of the re-concentrated acid is dispatched to the nearby plant of Saint Gobain, where it is used as such in fertilizer manufacture. The remainder is mixed with fresh 98% acid to make up for process losses and to bring the acid to the concentration required for the reaction.

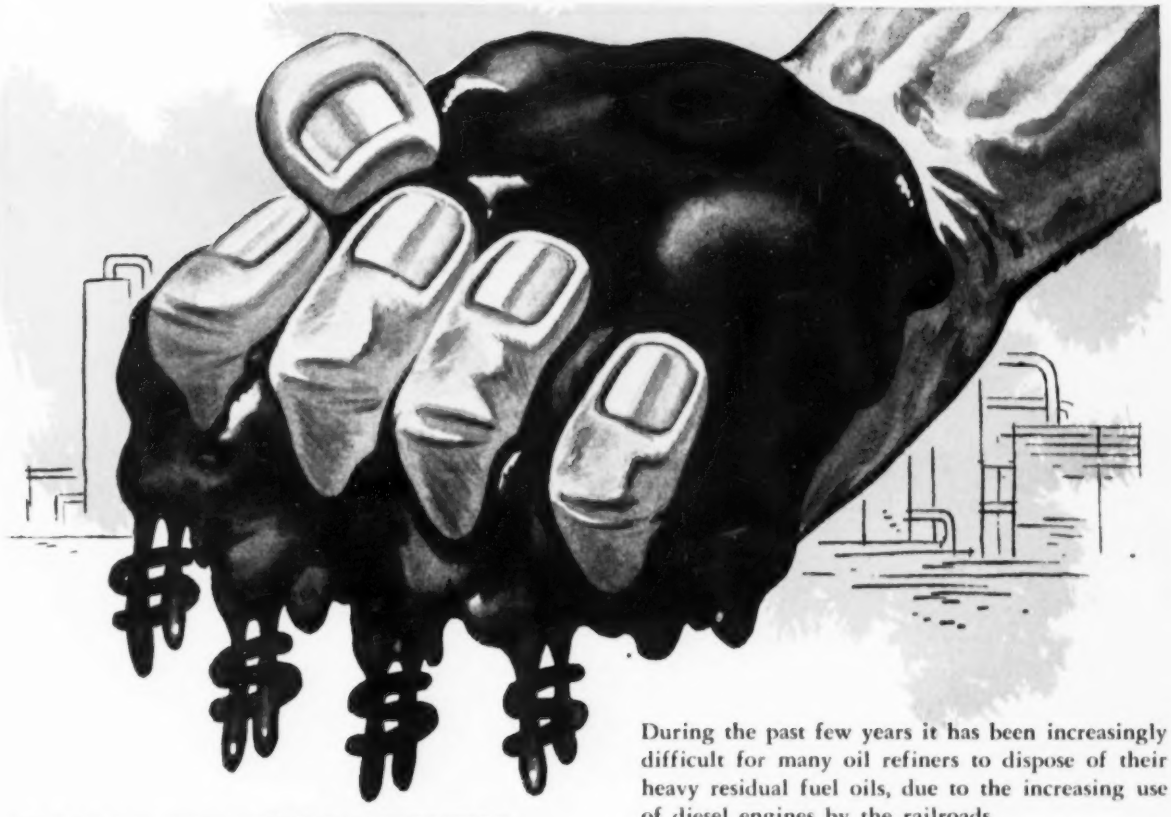
The isopropyl alcohol from the acid reaction unit is purified in the distillation section; the final product is the constant boiling mixture of isopropyl alcohol and water. Part of this product is shipped as such, but the greater part is converted to acetone by catalytic dehydrogenation.

The acetone constitutes the main final product; a considerable part, however, of the total quantity of acetone produced is used as starting material for the production of derivatives such as diacetone alcohol, mesityl oxide and methylisobutyl ketone, which also form part of the Shell-Saint Gobain solvents range.

The various products are purified in the distillation section to within the narrow specification limits; here provisions are made to eliminate various by-products formed during the manufacturing process.

The output of the plant will be absorbed by the French home market for use in the paint and lacquer and textile industries, or as starting materials for organic syntheses.

In addition to the Berre plant, Shell-Saint Gobain operates another petrochemical plant at Petit Couronne in France. That plant produces Shell's "Teepol," a sodium alkylsulfate detergent made from wax-based olefins.



HOW TO SQUEEZE PROFITS FROM YOUR HEAVY RESIDUAL OILS...

During the past few years it has been increasingly difficult for many oil refiners to dispose of their heavy residual fuel oils, due to the increasing use of diesel engines by the railroads.

The solution to this problem is the installation of a "Continuous Fluid Coking" unit, engineered and constructed by TRECO. This helps conserve national petroleum resources by making more gasoline and home heating oil from the same amount of crude, with greater profits to the refiner. The process will also aid in the exploitation of reserves of very low grade crude oils which until now could not be economically refined, and offers a greatly improved process.

The coke produced from "Continuous Fluid Coking" is suitable for refinery fuel, burning in power plant boilers or for other industrial applications. With some feed stocks the coke will likely be of greater value, for example, in the production of carbon electrodes for aluminum manufacturers.

TRECO is approved by Standard Oil Development Company to engineer and construct "Continuous Fluid Coking" units. Telephone, wire or write for information as to the possibilities of adapting this valuable new process to your operations.

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By arrangement with the Standard Oil Development Company, we are prepared to design and build Continuous Coking Units employing SOD's new fluid-coking process.

The process is especially adaptable for converting heavy fueloil or residuum into more valuable products. Charge-stock may be any reduced-crude or pitches that can be pumped to the unit.

The distillate-products are a high percentage of the throughput. The coke is produced in small particles and is handled as a fluidized solid. Operation is continuous, without periodic decoking.

If you have a problem of improving your refinery balance, we would like to work with you. We are prepared to make economic-studies, estimates, and design-outlines. We are prepared to engineer and build SOD fluid-cokers adapted to your needs.

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Platform Speeds up Stores Trailer Service

PORTABLE trailers have become rather commonplace equipment in the maintenance departments of most refineries. Most frequently used as a "general store" on wheels, or a portable annex to the refinery's main tool room and stores department, trailers are also used sometimes for special projects, such as insulation.

Early trailers were often put together by maintenance personnel from materials and supplies lying around the shop. More recently, trailers have been built by regular commercial trailer manufacturers to specifications made up by the refinery staff. A stores trailer at the East Chicago, Ind., refinery of Sinclair Refining Co. is an example.

However, it seems never to fail that hindsight is better than foresight. Somehow, one can almost always come up with a suggestion for some further improvement, some additional refinement, that wasn't thought of at first. In Sinclair's case, it was a movable platform and stairs, attached at the side "service" door of the trailer, as illustrated in the photograph. When not in use at a field location, the platform device (made of conventional walkway grating, pipe, and sections of plate) is folded up and rolled underneath the trailer body, out of the way. The overhead canopy drops down out of the way after the trailer door is closed.

Anti-Rust Paint Saves Coke Gondolas

RUST preventative paints have been found to give satisfactory service as protective coatings on coke gondolas at one large midwestern refinery. In use for a period of over six years, the materials were used as a replacement for conventional lead base paints which had been giving extremely short service life. The gondola cars undergo severe service conditions, being subject to heat, water, salt, and other corrosive substances.

A two-coat system is used, consisting of a base coat of red primer and a finish coat of black. The paint is of a type said to be applicable directly over rusted surfaces without any preliminary preparation; however the refinery has found that a thorough cleaning before paint application gives the best results.

The first application of the material to a gondola was made in June, 1947. Observation of this car in February, 1949, disclosed that although the finish coat was practically gone from the more abused surfaces, the base coat of primer, was still providing excellent protection. The black, finish coat scaled around rivets and side stakes, and there was some accumulation of rust in the welds. However, pits in the sills, which had been present even before the new material was used, were still well protected by the prime coat.

Coverage is better with the rust preventive material than with the lead base paint, the refiner has observed. It is believed this is particularly true where the surface is carefully cleaned prior to application.

The company has also tried the paint system as a coating on the firebox of one of its steam locomotives. Although this surface is subjected to dry heat, the paint has stood up reasonably well, it is said.

Similar coatings are now under test for use on storage tank walls, roofs, and other equipment, but the investigation has not yet progressed long enough to appraise the merits of the paints.

Tips on Ball Bearing Maintenance

AN essential role in the service life of an electric motor is played by shaft bearings. Proper fit, installation, and lubrication all are important factors in obtaining good service.

Following is a series of questions and answers, a portion of a successful day-long seminar on this problem conducted at the Aruba, Netherlands West Indies, refinery of Lago Oil & Transport Co. by Mr. Jack Cannon of Continental Electric Co. Because of its value to petroleum processing industries' maintenance engineers, Lago has kindly made some of this information available to PETROLEUM PROCESSING. The following questions and answers relate to fitting on the shaft.

If you are out on the job and find the shaft is smaller than the hole of the inner race, what can you do to fit the ball bearing?

Nothing in the field. The shaft must be brought into the machine shop and built up to the proper diameter, which is never less than a metal-to-metal fit.

What happens when you put a bearing on a shaft that is much too large for the hole in the bearing?

The inner race is stretched or expanded, and you lose all of the internal looseness of the ball bearing. A ball bearing cannot run properly without a certain amount of internal looseness.

What happens when you put a ball bearing on a shaft that is smaller than the hole in the bearing?

The bearing is never centered on the shaft. Therefore, it will act like a crankshaft which is forever pounding the balls and it will cause a failure in a short time if the shaft is turning at 1800 or 3600 rpm.

What happens when the inner race of a bearing turns on a shaft?

This will cause very great heat between the shaft and the inner race. The shaft and inner race will soon "gall," which means that they practically become stuck together.

What is wrong with heating the bearings in oil so as to expand them for fitting on the shaft?

Nothing, provided you know the temperature of the oil and keep it below 300° F., and further, that the oil is clean. Remember that the outer race of the ball bearing will expand about twice as much as the hole in the inner race, and you should not be able to get the outer race in the bearing housing at the same time that you are fitting the inner race on the shaft.

Is the inner race supposed to turn on the shaft?

No.

If the shaft diameter is too great for a bearing that is going to be installed in the field, can we fit the shaft in the field?

No, the shaft must be returned to the machine shop so that the diameter can be ground down to size. You cannot make a proper fit with emery cloth or a file.

Which is better, to expand a bearing with heat or to shrink the shaft with dry ice?

There is very little difference between these two methods. A better method than either one is to install the bearing properly on the shaft with a cold-rolled drift.

If you have a shaft and the bearing which came off had a metal-to-metal fit, but when you put on a new bearing it is too loose on the shaft, what do you do?

Try another new bearing. You may have had one in which the diameter of the inner race was on the large side. Carefully wrap the first bearing in clean paper and replace it in its box. Mark the box so that you know the inner diameter is large. Then you can use this particular bearing on a shaft that is larger than usual.

If the inner race of a bearing is so tight on the shaft that you cannot remove it except by burning it off, does this mean that you had too tight a fit to begin with?

Not necessarily. If the shaft was smaller than the hole and began to turn inside the inner race, you produced enough heat to gall the bearing surface to the shaft.

How can you check a new bearing installed on a shaft to see if the shaft diameter was too big for the I. D. of the inner race?

The new ball bearing should be checked for internal looseness before it is mounted on the shaft. This is done by feeling the lateral movement between the inner and outer races at the position of each ball. When this new bearing has been drifted about one-third of the way on the shaft, the inner race has been stretched, or expanded, as much as it ever will be, provided the shaft is not tapered.

When the bearing is one-third of the way on the shaft, then feel the lateral movement of the outer race against the balls. If you still have some movement, then you still have some internal looseness and you can proceed to drift the bearing on the shaft against the shoulder. It is a good idea to check this internal looseness again when the bearing is home, to make doubly sure that it turns freely and has some lateral movement.

What effect does a hot bearing have on a shaft?

This question is not very clear. However, if a bearing becomes so hot that balls seize between the inner and outer races, then the inner race usually turns on the shaft, and that will cause galling. This means the metal of the inner race and the shaft stick to each other.

Preventing Freeze-ups In Pressure Controls

ALL gasoline plants are built so as to be as automatic as possible. Part of this is accomplished by the use of motor-operated valves, regulated by pressure controllers. However, it becomes somewhat of a headache to keep motor valves functioning properly during extremely cold weather.

In examining the causes of these freeze-ups, we have discovered that a large part of the trouble was due to moisture getting into the diaphragm and the bourdon tubing of the pressure controller, even though we have air and gas drying equipment.

To eliminate the trouble, two holes were drilled in the back of the pressure controller case, one on each side of the diaphragm housing. Then copper tubing was inserted through one side, wound around the diaphragm housing and led out the other side. Steam flow through this tubing keeps the inside of the pressure controller case warm enough to prevent freeze-ups. We have installed about 50 of these in the plant at relatively low cost, and have virtually eliminated the trouble.

The preceding item is based on a prize-winning "Plant Kink" by Ovid Phillips, Warren Petroleum Corp., Gladewater, Texas, and presented at the Tyler, Texas, meeting of the Natural Gasoline Association of America, October, 1952.

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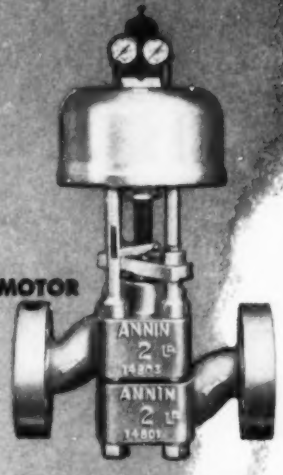

Model 2560, series 90-150, pressures to 3600 psi; temperatures —325° F to 1200° F. Model 3560, series 250, to 6000 psi.

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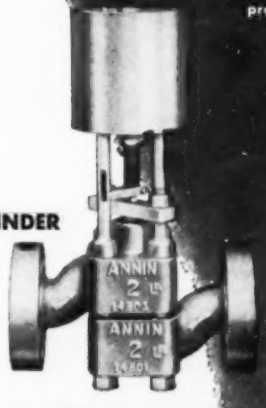

Model 2520, series 90-150, pressures to 3600 psi; temperatures —325° F to 1200° F. Model 3560, series 250 to 6000 psi.

Model 25, series 90-150, pressures to 3600 psi; temperatures from —325° F to 1200° F. Model 35, series 250, to 6000 psi.

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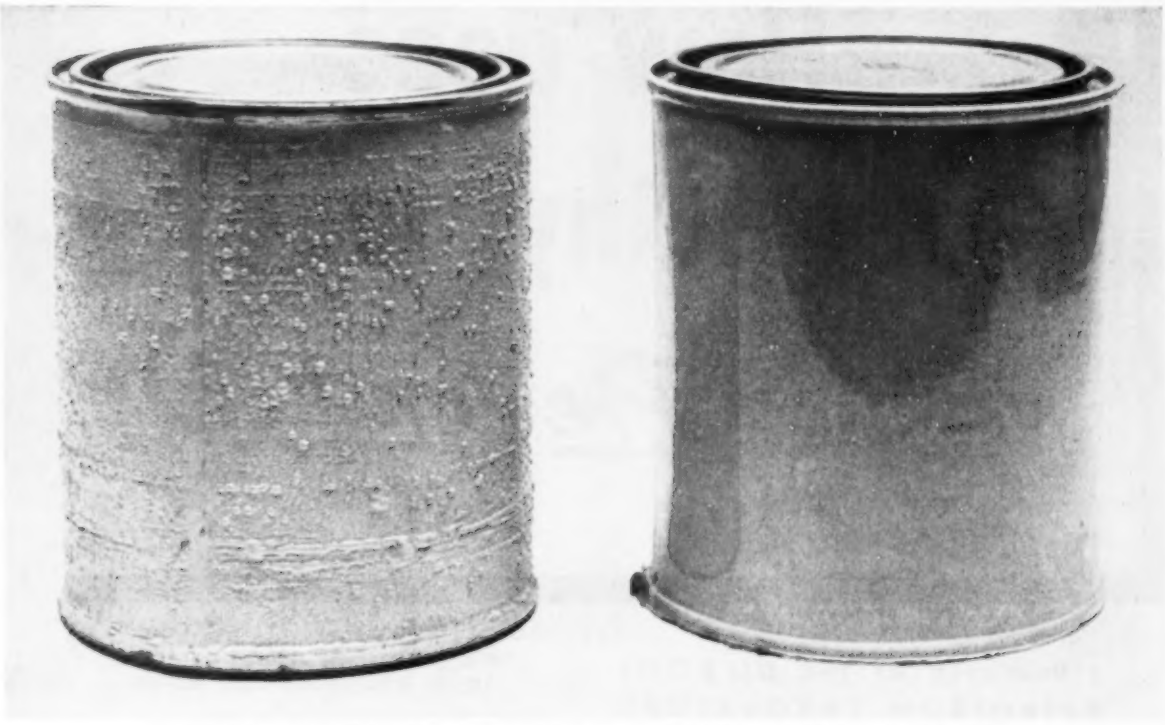

HYDROGEN BLISTERING tendency in process water is revealed by appearance of can at left

Painted Can Serves as Fast Corrosion Test

A small, painted, 1-pint can has become a useful laboratory device for testing water accumulations from refinery equipment for corrosive agents. Developed as a test by Shell Oil and Shell Development Co. technologists, the method has been used to evaluate the effect of polysulfide solution injections in the overhead vapor lines of distillation equipment. Details are as follows.

The can, a friction-lid steel container of 1-pt. capacity, should first be cleaned with acid to remove any non-ferrous coating from the inside. It is then washed with water to remove any trace of acid and allowed to dry. Then two heavy coats of rubber-base paint are applied to the external surface of the can. Within 10 days after this painting, the can should be used.

Just before the solution to be tested is placed inside the can, any rust on the inside should be cleaned out with concentrated hydrochloric acid, and the acid quickly washed out. Immediately, the can should be filled with the solution to be tested, and the lid placed on tightly.

The time required for the paint to blister decreases with an increase in temperature. Therefore, in a series of tests, the temperature of the solution in the can should be approximately the same for each test. At temperatures of 90° F., accumulator waters have blistered the painted cans in less than 30 minutes. With other samples, no blistering has been observed in the course of two weeks. An example of a severely blistered can is shown at left in the photograph.

In that instance, the strongly corrosive accumulator water has attacked the inside surface of the can. Atomic hydrogen formed as a result of this corrosion has diffused through the steel and has combined to form molecular hydrogen underneath the paint film. The blisters observed are under the paint but not in the steel.

To blister the steel can itself, a longer exposure is required, and this will depend upon the quality of the steel. A control test can, through which no hydrogen penetration has occurred, is at the right in the same photograph.

Rapid, Automatic Oxidation Tester

AN automatic oxygen absorption unit for running two oil oxidation tests simultaneously has been developed, built, and put into use at the Pure Oil Research & Development Laboratories at Crystal Lake, Ill.

In operation, oxygen is bubbled through the sample of oil at properly controlled temperature, and the rate at which it is consumed is measured and recorded.

Complete details and a series of pictures of this unique shop-built apparatus are given in a four-page article in this issue beginning on page 1524.

How does tetraethyl lead reduce *Pre-Ignition*?

• Research at the DU PONT PETROLEUM LABORATORY designed to help refiners solve pre-ignition problems through the use of additives

At present, pre-ignition during road operation threatens to limit further improvement in the efficiency of fuel utilization in passenger-car engines.

However, on the basis of extensive pre-ignition research, the Du Pont Petroleum Laboratory believes this problem may be solved in one or more ways.

The solution to the problem has been sought by:

1. Reducing the tendencies of combustion chamber deposits to glow and cause surface ignition of the charge.
2. Improving the ability of fuels to withstand ignition by such hot surfaces.

CERTAIN ADDITIVES reduce deposit glow and offer a solution to the problem. However, as engine compression ratios are increased still further it may also be necessary to increase the pre-ignition resistance of the fuels themselves.

EFFECTIVENESS OF TETRAETHYL LEAD AS AN ANTI-PRE-IGNITION AGENT

Some hydrocarbons are more sensitive than others to ignition by glowing deposit particles. Preflame reactions tend to sensitize the fuels to ignition. The effect of these preflame reactions can usually be minimized by tetraethyl lead, thus increasing the pre-ignition resistance of the gasoline.

CONTINUING STUDIES

This research on pre-ignition is part of a continuing program by the Du Pont Petroleum Laboratory. More complete details on these investigations can be obtained from any Du Pont Petroleum Chemicals Division district office listed below. Ask for papers entitled "Pre-Ignition in Automotive Engines" and "An Investigation of Pre-Ignition in Engines."

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By Peter J. Gaylor, Patent Attorney, Newark, N. J.

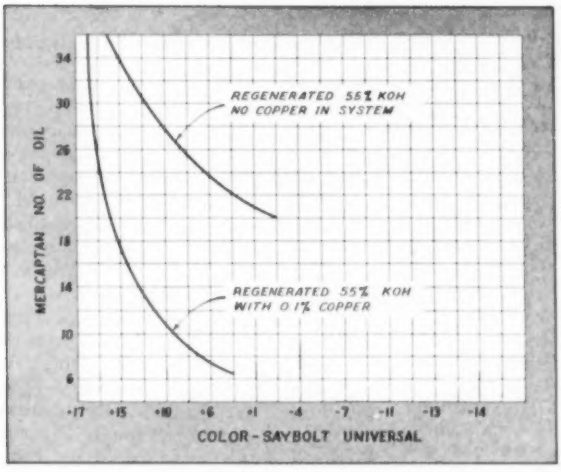

FIG. 1—Graph showing effect of copper catalyst on color removal in new mercaptan sweetening process

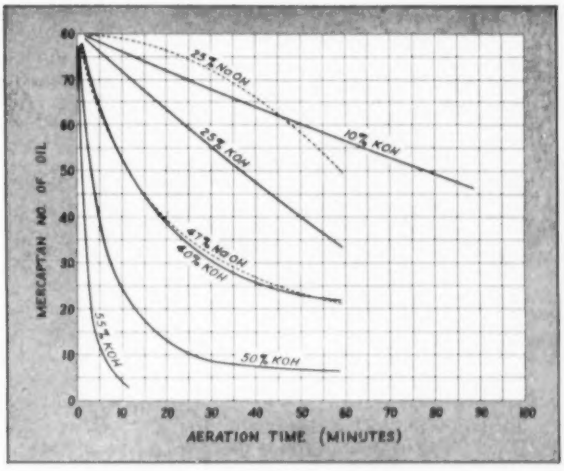

FIG. 2—Chart tracing superiority of KOH over NaOH in treating mercaptans. Also shows leveling-off effect

Convert Mercaptans to Disulfides With Oxygen, Copper Catalyst

REMOVAL of mercaptans from higher boiling stocks such as kerosine and heater oils is more difficult than with naphthas because of the increased oil solubility of the mercaptans present. Color degradation often results from the treatment.

In the Standard Oil Co. (Ind.) Patent 2,646,389, it is reported that mercaptans can be removed from sour heavier distillates without serious color formation by treating with a controlled amount of air or oxygen in presence of aqueous KOH of 50-60% weight concentration at 80-125° F. in presence of a particular type of copper catalyst. Under such conditions, the mercaptans are converted to disulfides without formation of objectionable color bodies, and the oil is claimed to be satisfactory from the standpoint of its burning characteristics when employed in sleeve-type burners. The amount of oyxgen used is 1½-2½ times that theoretically needed to convert mercaptans present to disulfides.

The treating reaction is greatly facilitated by presence of .004-.1% of copper, based on the weight of KOH solution used. The copper is in the form of a catalytically active copper compound or complex such as colloidal copper oxide, which corresponds to .01-.3% of Cu Cl_2. $2H_20$. The copper is added directly to the KOH solution which is hot enough to avoid formation of a black precipitate. In this case, a blue complex forms and the copper is claimed to remain in an active condition and does not precipitate out. The presence of oxygenated hydrocarbon "poisons" in regenerated caustic "consumes" the copper catalyst to form a precipitate which must be removed to prevent clogging of lines.

Use of the copper catalyst is claimed to give a phenomenal increase in the mercaptan oxidation rate with markedly improved Saybolt color. The higher the treating temperature, the more rapid is the sweetening and the better the color. Apparently the catalyst directs the oxidation toward conversion of mercaptans to disulfides rather than to color bodies, probably phenolic substances.

Fig. 1 shows data obtained by treating 500 cc. of sour West Texas heater oil with 1% by volume of KOH solution at 120° F. and air at the rate of 4.85 Cf/hr. The upper curve shows rapid formation of color as the mercaptan number of the oil is reduced when treated with air and regenerated 55% KOH. The lower curve shows the improved results obtained with the same KOH solution containing 0.1% Cu $Cl_2.2H_20$.

Temperature is desirably at 80°-125° F. Higher temperatures beyond this range increase color formation. It is desirable to separate the oil from the caustic after a contact time of 25-40 min. in order to avoid color formation.

Fig. 2 depicts the superior action of KOH in comparison to NaOH solutions. Aeration time for reduction in mercaptan number from 80 to 60 was about 48 min. with 25% NaOH and only 24 min. with 25% KOH. This drawing also shows the effect of concentration on the rate of mercaptan oxidation. There is a tendency for the oxidation to cease or level off at a given mercaptan number, depending on the concentration. Thus, a 40% KOH leveled off at a mercaptan number of 22, whereas 50% KOH permitted the mercaptan number to be reduced to about 7. Odor is claimed to be satisfactory for marketing.

Data are presented also to show that much less copper catalyst is needed when the catalyst is added directly to the sour oil before introduction of caustic.

Tellurium Catalyst Oxidizes Methylenes to Carbonyls

USE of tellurium dioxide in stoichiometric amounts for oxidizing organic compounds has been disclosed in the past. Selenium dioxide also has been used, but the two apparently do not act the same way on the same compounds. U.S. Patent 2,648,638, issued to Socony-Vacuum Oil Co., points out that although selenium and tellurium are generally

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listed together as having similar properties, this is not generally the case. For example, when selenium is used as a catalyst, copious amounts of hydrogen selenide are obtained. On the other hand, tellurium does not form a telluride under the conditions specified. Also, selenium dioxide is extremely soluble in water and alcohols, whereas tellurium dioxide is almost quantitatively insoluble in the same solvents.

The patent proposes to use tellurium as an oxidation catalyst for the oxidation of methyl and methylene groups to carbonyl groups. For example, when propylene is mixed with air and passed over a tellurium catalyst, acrolein is produced in yields of over 5 mol % per pass. The tellurium can be used for some time. Reaction temperature is 600°-650° F. A Ca refinery gas containing 52% propylene was oxidized similarly at atmospheric pressure at 752° F. with a space velocity of 8. The product was absorbed in water at below 10° C. and analysis of the aqueous solution indicated that 12.6% of the propylene charged was converted to acrolein (12.6% conversion per pass).

When isobutylene was oxidized in this way, methacrolein was formed, about 6.9% of the olefin being converted per pass to the compound. Toluene was converted to benzaldehyde in a similar manner. Ethylene can be oxidized to glyoxal.

The catalyst is finely divided and it can be supported or unsupported. The claims specify the volume ratio of the compound oxidized to air to be between 1:1 and 1:9, sufficient contact time being given to oxidize at least 50% of the tellurium to an oxide.

Fractionating Sweetened Distillate

IN the Standard Oil Development Co. Patent 2,636,842 there is disclosed the distillation of at least a partially sweetened fraction of gasoline or kerosene containing disulfides susceptible to thermal decomposition, involving admixing with the hydrocarbon a treating reagent consisting of an oil in the lubricating oil range, an alkali metal sulfonate and an alkali metal hydroxide. The mixture is distilled, and a doctor sweet fraction is obtained which is free of mercaptans and disulfides.

The treating agent, prior to addition of caustic, should contain 75-90% lubricating oil (solvent extract) and 10-25% metal sulfonate (such as sodium sulfonate). The partial sweetening may be effected by hypochlorite, oxidation, etc.

Sweetening Sour Distillates

THE sweetening of mercaptan-containing distillates boiling up to 750° F. by contacting with caustic is proposed in U. S. Patent 2,638,439 issued to Standard Oil Development Co. Prior to contacting with caustic, the distillate has added to it a small but effective catalytic amount of an organic fraction obtained by acidifying a solution of an alkali metal salt of crude petroleum phenol to at least 75% of a methyl orange end point to release an acidic fraction which is discarded. The retained solution then is further acidified to the methyl orange end point to release the organic fraction which is added to the sour distillate.

The sweetening operation is conducted in presence of a mild oxidizing agent to convert mercaptans to disulfides. The organic fraction is added in an amount of 0.01-0.15% by volume. The alkaline solution preferably is of 30-50% Bé gravity. One example given describes treatment of a heating oil boiling at 400-650° F. having a copper number of 40, which was reduced to 1 in 1 hr. The effect is presumably shown to be not due to naphthenic acids.

Patents Issued in August

The following classified listing gives the patent number, patentee, or assignee, and a brief description of all patents believed to be of interest to the petroleum processing industries, as contained in the Official Gazette of the U. S. Patent Office for August 4, 11, 18 and 25, 1953, Vol. 673, Nos. 1-4.

PROCESSES

Refining

2,647,855-6 (Universal Oil Products Co.) Apparatus and process for countercurrent liquid-liquid extraction.
2,647,858 (Socony-Vacuum Oil Co.) Oil decolorization method with water insoluble inorganic metal fluoride.
2,647,862 (Phillips Petroleum Co.) Process and apparatus for vacuum distillation.
2,648,205 (Hydrocarbon Research, Inc.) Rectification of mixed gases.
2,648,624 (The Texas Co.) Azeotropic distillation for recovery of aromatic fractions containing naphthalene.
2,649,166 (Allied Chemical & Dye Corp.) Absorption of carbon dioxide from gases containing the same, using liquid polyglycol ether.
2,650,154 (Tide Water Associated Oil Co.) Production of sulfur from hydrogen sulfide, using SO_2 and oxygen.
2,650,187 (Socony-Vacuum Oil Co.) Color stabili-

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zation of fuel oils by extraction with polyethylene glycol.
2,650,188 (Sun Oil Co.) Preparation of lubricating oil (naphthenic) by treating with ammonia and NaOH prior to distillation.
2,650,202-3 (Tide Water Associated Oil Co.) Production of silicate adsorbent.

Catalysts

2,647,875 (Socony-Vacuum Oil Co.) Process of preparing an inorganic oxide hydrogel.
2,648,638 (Socony-Vacuum Oil Co.) Method for preparing a tellurium oxide-containing catalyst.
2,648,639 (Standard Oil Development Co.) Calcium manganate-aluminum oxide catalyst.
2,649,419 (Sun Oil Co.) Molybdenum disulfide containing hydrogenation catalyst.
2,649,420 (Celanese Corp. of America) Preparation of barium-chromium-copper-silica-containing catalyst.
2,650,155 (Shell Development Co.) Apparatus for stripping and regenerating spent adsorptive powders.
2,650,200 (E. I. du Pont de Nemours & Co.) Process of making a concentrated silica sol.
2,650,201 (Universal Oil Products Co.) Production of phosphoric acid catalyst.

Conversions

2,647,857 (Gulf Research & Development Co.) Hydrodesulfurization process using catalyst of iron group.
2,647,859 (Houdry Process Corp.) Process and apparatus for the disengagement of gases from fluent solid particles in the conversion of hydrocarbons.
2,647,860 (Socony-Vacuum Oil Co.) Process for continuous hydrocarbon conversion with a silica-alumina-chromium oxide catalyst.
2,648,623 (Anglo-Iranian Oil Co.) Catalytic hydrodesulfurization of petroleum hydrocarbons, using catalyst immune to sulfur poisoning.
2,649,340 (Houdry Process Corp.) Operation procedure for gas lifts.
2,649,358 (M. W. Kellogg Co.) Contacting gases and solids.
2,649,486 (Stratford Engineering Corp.) Process for preparing olefinic hydrocarbons and recycle acid catalyst for absorption prior to alkylation.
2,650,189 (Anglo-Iranian Oil Co.) Catalytic cracking of dewaxed petroleum hydrocarbons.

Hydrocarbon Synthesis

2,649,468 (Hydrocarbon Research, Inc.) Hydrocarbon synthesis process and the production of synthesis gas.

PRODUCTS

Chemicals

2,647,861 (Standard Oil Development Co.) Purification of ketones by distillation.
2,647,930 (Commercial Solvents Corp.) Catalytic reduction of nitroolefins.
2,647,931 (Universal Oil Products Co.) Alkylation of phenolic compounds.
2,647,934 (Phillips Petroleum Co.) Process for dehalogenation of organic compounds.
2,648,594 (Socony-Vacuum Oil Co.) Manufacture of ammonium sulfate from refinery wastes.
2,648,598 (U.S.A.) Process for determination of ethylene in gases.
2,648,631 (Ethyl Corp.) Fused salt electrolysis cell.
2,648,640 (Universal Oil Products Co.) Lacquer composition containing a hydrocarbon derived resin.
2,648,692 (Standard Oil Development Co.) Process for making ethereal esters from aliphatic aldehyde esters and aliphatic alcohols.
2,648,693 (Universal Oil Products Co. (Polyalkylene glycol esters of alkyltetrahydrophenylalkanoic acids.
2,648,694 (Standard Oil Development Co.) Higher fatty acid synthesis from oxo bottoms.
2,648,695 (Shell Development Co.) Intramolecular esters of hydroxy or amino phosphinic acids.
2,648,696 (Shell Development Co.) Mixed acid anhydrides and process for production of same.
2,648,711 (Standard Oil Development Co.) Recovery of alcohols from direct hydration of olefins.
2,648,712-3 (Sun Oil Co.) Separation of isomeric aromatic compounds.
2,649,406 (Gulf Research & Development Co.) Separation of acetone and propionaldehyde by azeotropic distillation with chloroform.
2,649,407 (Gulf Research & Development Co.) Separation of ethyl acetate and ethanol by azeotropic distillation with methanol.
2,649,463 (M. W. Kellogg Co.) Preparation of olefin oxides.
2,649,473 (Universal Oil Products Co.) Substituted carbamic acid esters as surface active agents.
2,649,485 (Imperial Chemical Industries Ltd.) Production of methyl acetylene.
2,650,198 (Shell Development Co.) Oil-soluble ammonium petroleum sulfonates.
2,650,209 (Standard Oil Development Co.) Synthetic cyclopentadiene drying oils and methods for preparing same.
2,650,211 (Shell Development Co.) Polyesters of alkenyl-succinic acids.
2,650,236 (Phillips Petroleum Co.) Preparation of furans.
2,650,239 (Socony-Vacuum Oil Co.) Preparation of chromic salts.
2,650,253 (Shell Development Co.) Production of higher ketones from olefin and aldehyde.

Fuels

2,647,364 (M. W. Kellogg Co.) Pulse jet engine with spontaneously ignitable fuel and oxidizer.
2,648,317 (Libor Mikulasek and Milan Strnad) Operation of combustion motors by hydrazine.
2,648,499 (Standard Oil Development Co.) Variable oil-gas fuel control system.

Lubricants

2,647,824 (Standard Oil Development Co.) Stabilized hydrocarbon compositions containing hydrogenated quinolines with oxidation inhibitors.
2,647,872 (Shell Development Co.) Grease composition using inorganic gelling agent.
2,647,873 (Shell Development Co.) Lubricating compositions containing condensation product of alkyl phenol with aldehyde.
2,647,889 (Standard Oil Co.-Ind.) Preparation of barium salts of phosphorus sulfide-hydrocarbon reaction products.
2,648,633 (Shell Development Co.) Grease compositions based on colloid containing inorganic nitrite.
2,648,634 (Shell Development Co.) Method of preparing lubricating grease compositions (use of quenching, etc.).
2,649,165 (Sinclair Research Laboratories, Inc.) Grease compacter.
2,649,416 (Socony-Vacuum Oil Co.) Lubricating oil containing a mono-ester of a thiodiacetic acid.

Specialties

2,647,874 (John B. Pierce Foundation) Automotive coolant (isoalkyl orthosilicates).
2,648,612 (Irven G. Cooper) Sealing composition containing paraffin and paraffin oil.
2,648,643 (Standard Oil Development Co.) Wax-isobutylene polymer engine corrosive preventive.
2,648,691 (Universal Oil Products Co.) Stabilization of fatty compound material with organic sulfur.
2,649,360 (Jefferson Lake Sulphur Co.) Carbon black furnaces.
2,649,384 (Shell Development Co.) Asphalt blowing flux and process of preparing the same.
2,649,397 (Shell Development Co.) Fungicidal compositions and method of fungus control comprising hydrocarbyl-substituted pyrimidines.

Miscellaneous

2,647,403 (Universal Oil Products Co.) Flow measuring apparatus.
2,647,405 (Socony-Vacuum Oil Co.) Catalyst level indicator.
2,648,376 (Standard Oil Development Co.) Flare stack lighter.
2,649,059 (Societe pour le Renforcement des Domes de Reservoirs a Petrole) Hydrocarbon storage tank with strengthened roof.
2,649,843 (Phillips Petroleum Co.) Double diaphragm unit.

EQUIPMENT

Processing, general

2,647,485 (Union Machine Co.) Apparatus for proportioning liquid mixture.
2,647,587 (Union Oil Co. of Calif.) Apparatus for solids flow control.
2,647,855-56 (Union Oil Products Co.) Apparatus and process for counter-current liquid-level extraction.
2,647,859 (Houdry Process Corp.) Process and apparatus for disengagement of gases from flu-

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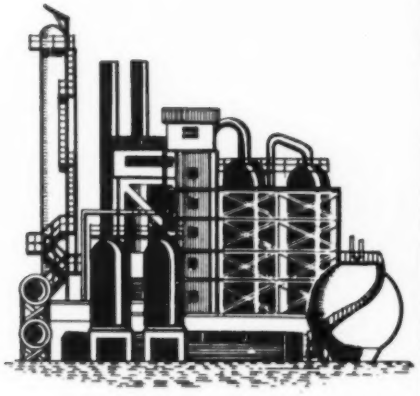

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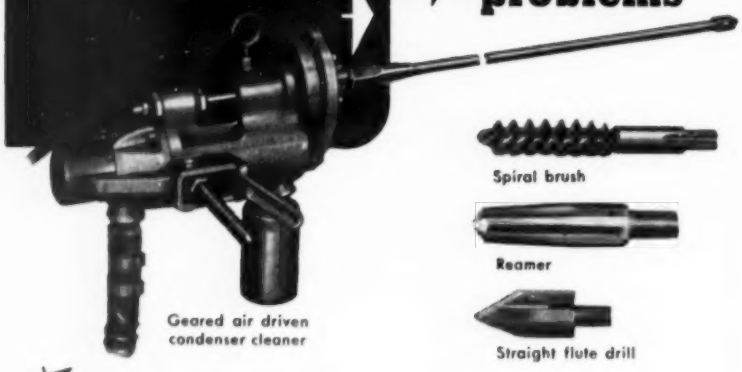

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Patents

ent solid particles in the conversion of hydrocarbons.
2,647,863 (Foster-Wheeler Corp.) Apparatus for control of distillation reflux.
2,648,375 (Minneapolis-Honeywell Regulator Co.) Electronic burner control apparatus.
2,648,376 (Standard Oil Development Co.) Flare stack lighter.
2,648,496 (American Cyanamid Co.) Centrifugal apparatus for separating gases from liquids.
2,648,499 (Standard Oil Development Co.) Variable oil-gas fuel control system.
2,648,527 (Orson A. Carnahan) Heat exchanger.
2,648,976 (John F., John W., and Frank Robb) Method and apparatus for gas sampling and recording analyses and temperatures.

Instruments

2,647,401 (Claude M. Hathaway) Thermal flowmeter.
2,647,402 (Negretti & Zambra, Ltd.) Flowmeter.
2,647,405 (Socony Vacuum Oil Co.) Catalyst level indicator.
2,647,406 (Immanuel Sorenson) Liquid level gage.
2,648,009 (Consolidated Engineering Corp.) Mass spectrometer.
2,648,058 (Standard Oil Development Co.) Liquid level indicating device.
2,648,534 (Erhard Mettler, Johann Meier) Analytical balance.
2,648,981 (Willard M. Drake, Jr.) Flowmeter.
2,648,982 (Minneapolis-Honeywell Regulator Co.) Liquid level indicating apparatus.
2,648,983 (Weston Electrical Instrument Corp.) Electrical thermometer for measuring high temperatures.
2,649,011 (Standard Oil Development Co.) Analytical sample cell.
2,649,713 (Lee R. Dunavant) Liquid metering apparatus.
2,649,714 (E. I. duPont deNemours & Co.) Liquid level gage.
2,649,771 (Ashbury Parks) Liquid level control apparatus.
2,650,306 (Consolidated Engineering Corp.) Mass spectrometer.

Pumps & Compressors

2,648,287 (Thompson Products, Inc.) Flexible rotor pump.
2,648,288 (William J. Marks) Fluid pump.
2,648,289 (James P. Johnson) Rotary pump.
2,649,050 (Dunlop Tire and Rubber Corp.) Centrifugal pump.
2,649,274 (Rockwell Mfg. Co.) Plug valve body.
2,649,737 (Kenneth H. Hoen and Ruby E. Archer) Hydraulic pump.
2,649,739 (Hondaille-Hershey Corp.) Constant pressure variable displacement pump.

Valves & Fittings

2,647,531 (Ralph N. Brodie Co.) Flow control valve.
2,647,535 (Dunlop Rubber Co. Ltd.) Fluid pressure valve.
2,647,538 (Minneapolis-Honeywell Regulator Co.) Manually and fluid pressure operated valve.
2,649,113 (American Steel Foundries) Pressure selector valve.
2,649,275 (Howard Noyes) Shut-off or selector valve.
2,649,773 (Donald G. Griswold) Differential pressure operated valve.

Seals & Gaskets

2,647,774 (General Electric Co.) Vacuum seal.
2,647,777 (Victor Mfg. & Gasket Co.) One-piece sealing device.

Tanks & Vessels

2,647,654 (Alois Cibulka) Floating roof for tanks.
2,647,656 (Foster-Wheeler Corp.) Fluid vessel.
2,647,657 (B. F. Goodrich Co.) Diaphragm for storage tanks.
2,648,457 (Chicago Bridge & Iron Co.) Floating roof.
2,649,059 (Societe pour le Renforcement des Domes de Reservoirs a Petrole) Hydrocarbon storage tank with strengthened roof.

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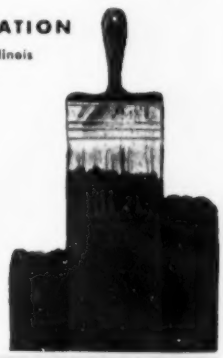

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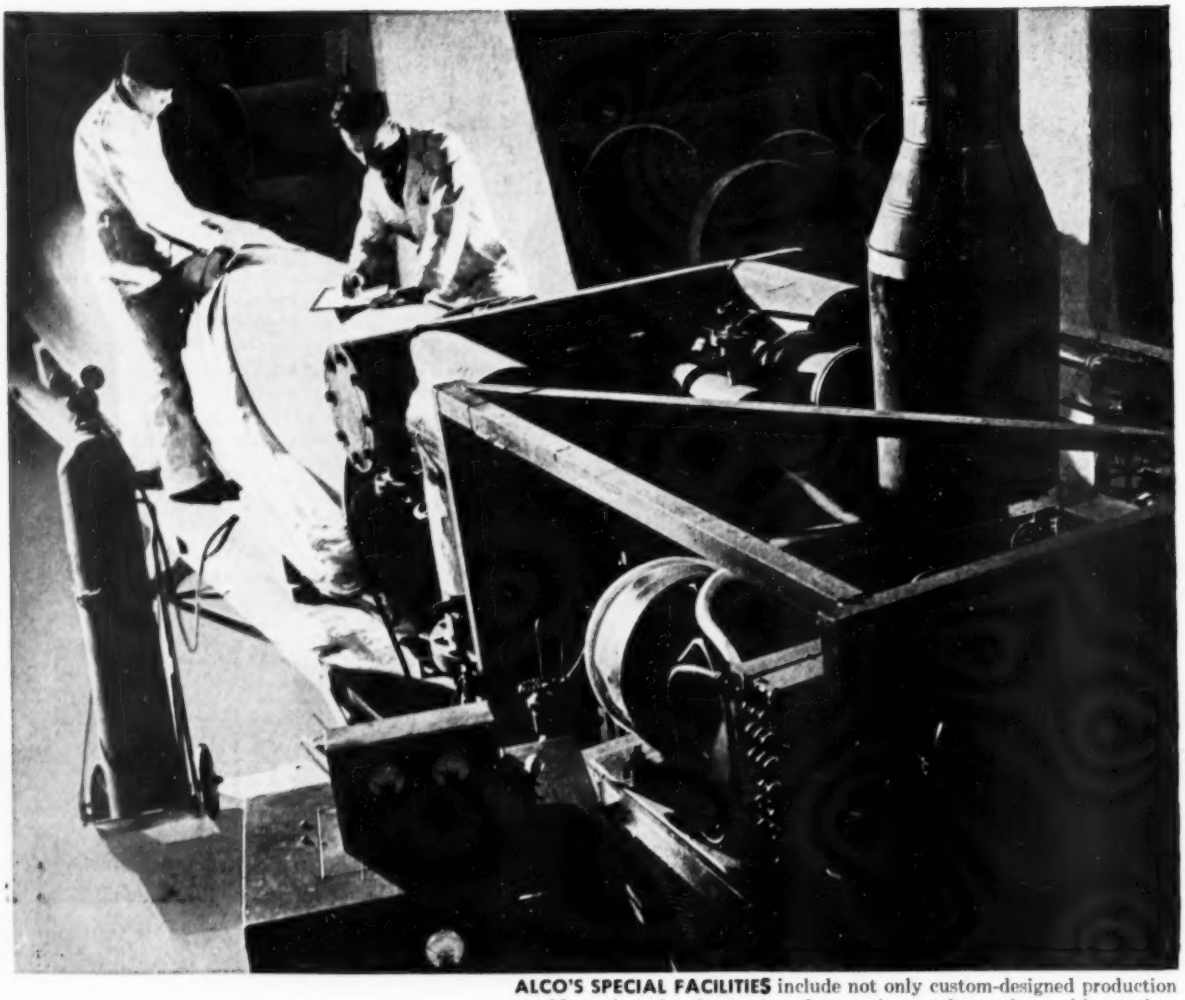

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Answers to

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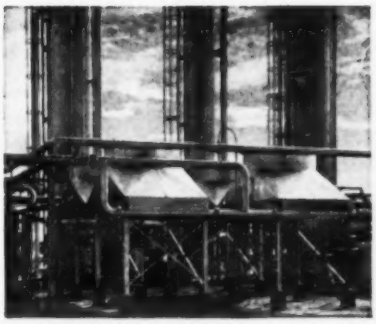
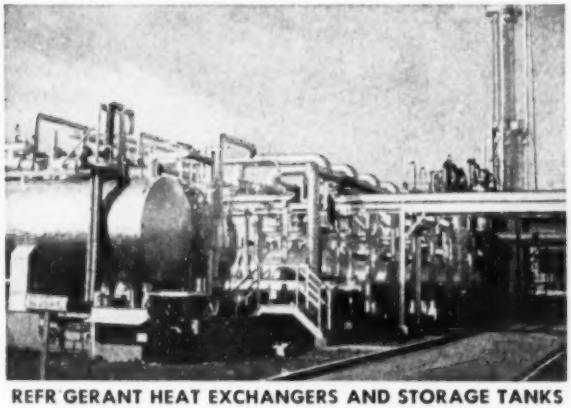
84-INCH ALCO STEEL PIPE at Croton Falls, N.Y., is part of the gigantic aqueduct system furnishing New York City with approximately 1050 million gallons of water per day. Alco Electric Welded Steel Pipe for interliners was also used in part of the New York City Board of Water Supply's new $44,000,000 East Delaware Tunnel, now nearing completion.

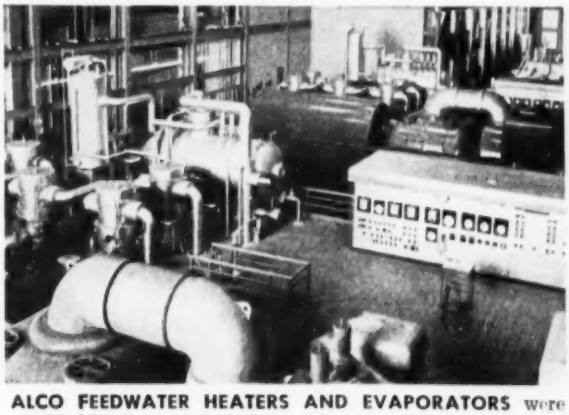


"UNI-BUNDLE UNITS" demonstrate the versatility of Alco Aircoolers. Vertical partitions welded in the headers allow several different vapor or liquid streams to be handled in a combined tube-bundle. Units are shown here at a large Southwestern natural gasoline plant; the one at right not only cools the oil but also condenses the overhead vapor from the steam.

HUGE TAR STILL, equipped with two corrugated furnaces for direct firing, typifies the virtually endless variety of heavy metal equipment built by Alco to meet special customer requirements. This is the type of equipment which has earned for Alco the confidence of power, petroleum and chemical companies all over the world.



REFRIGERANT HEAT EXCHANGERS AND STORAGE TANKS were among the variety of heavy-duty equipment built by Alco for Tennessee Gas Transmission Company's Hydrocarbon Recovery Plant at Gabe, Kentucky. Alco has over 50 years of experience in the design and fabrication of heavy-duty equipment for sub-zero operation.



ALCO FEEDWATER HEATERS AND EVAPORATORS were specified for the two 66,000 kw turbine-generator units installed in 1949 by Philadelphia Electric Company at its modern Barbadoes Island Station. Each evaporator delivers about 20,000 lb of make-up per hour. The feedwater heaters handle 555,000 lb of condensate per hour and deliver feedwater at 406 F.

New Industrial Problems

ALCO

ALCO PRODUCTS DIVISION

AMERICAN LOCOMOTIVE COMPANY • DUNKIRK, NEW YORK

 (To obtain more data on advertised products see page 1584)

"WHERE DO YOU GET YOUR ALKALIES, JIM?

"I ALWAYS GO TO SOLVAY *FIRST* FOR ALKALIES···*Here's why...*

SOLVAY

Soda Ash
Caustic Soda
Caustic Potash
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Potassium Carbonate
Calcium Chloride
Sodium Bicarbonate
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Monochlorobenzene
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Ortho-dichlorobenzene
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Sesquicarbonate of Soda

...First off, I've found that Solvay always takes care of its customers—in good times and bad! I know I can really depend on Solvay in a pinch.

I also like the treatment I get from the sales staff—always courteous and helpful. And it's convenient doing business with Solvay because one of their sales offices is located near me.

In addition, I feel that when I buy alkalies, I might as well get the "extras" that Solvay offers ...like the Solvay Technical Bulletins that give you the kind of information no other technical bulletins have. Same with the Solvay Technical Service staff, a group that operates on an industry-wise basis, with men who are experts in individual industries.

Then Solvay has over 200 local stock points that practically cover the country, and three centrally located plants. This makes for better delivery service.

And, of course, I know I get dependable quality and uniformity when I order from America's oldest and largest producer. That's why I always go to *Solvay first* for alkalies.

SOLVAY PROCESS DIVISION

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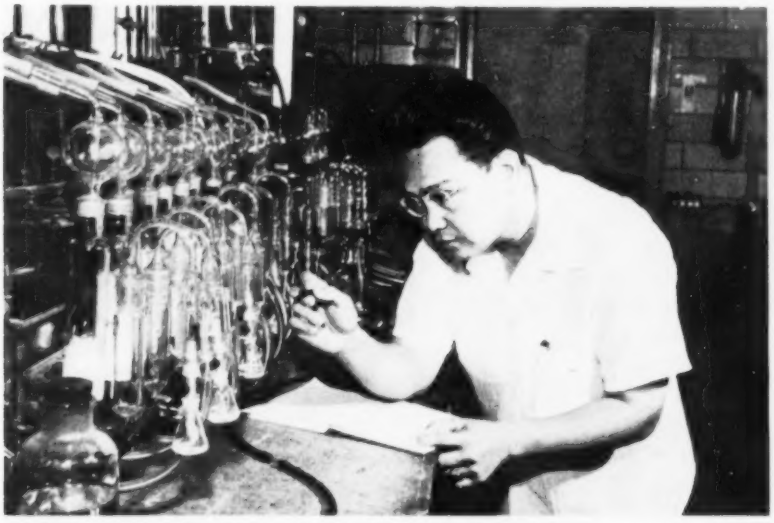
(*To obtain more data on advertised products* **see** *page* 1584)



FROM THE PHILIPPINES to Marcus Hook, Pa., comes Sixto Acuna, 32-year old chemical engineer from Manila. Now working in Sun Oil Co.'s refinery laboratory, Mr. Acuna is believed to be the first Filipino to come to this country to acquire practical knowledge of petroleum refining technology. After two years study with Sun, he will return to his island home to help spark the birth of a petroleum industry in that area

Harris Bateman, chief engineer of Cities Service Oil Co. and Cities Service Pipe Line Co. has returned to his post after completing a year's assignment as director of Materials Division, Petroleum Administration for Defense.

In addition to resuming his old responsibilities, Mr. Bateman will supervise activities of the purchasing, warehouse and surplus materials departments.

A. P. Lien, G. M. Webb, A. W. Lindert and **J. F. Snuggs** have been promoted to assistant division directors, newly-created posts in the Whiting, Ind. research laboratories of Standard Oil Co. (Ind.).

Dr. Lien will serve in the chemical products division, Dr. Webb in the hydrocarbon research division, Mr. Lindert in the heavy oil products division and Mr. Snuggs in the process division.

In the hydrocarbon research division, **Dr. C. E. Johnson** and **Dr. H. S. Seelig** have been named section leaders, and **Dr. W. A. Wilson,** group leader.

Carol E. Coleman is now the district secretary in charge of the Central States Office of the Liquefied Petroleum Gas Association. He replaces **Robert C. Tanner,** who resigned to accept another position.

Mr. Coleman is making his headquarters in the Kaufman Bldg. in Wichita, Kans.

Charles E. Webber, Sun Oil Co., has been named chairman of the main Technical Committee of the Natural Gasoline Association of America, and **Roy Schuster,** Chicago Corp., is the new vice chairman.

Mr. Webber

In announcing the appointments, NGAA president Frank M. Perry said "the number and diversity of important studies have expanded so greatly in recent years that we have had to assign supervision of technical activities to the main committee and set up sub-groups to handle specific problems."

Chairmen and vice chairmen appointed to the various working subgroups of the technical committee are: Sub-Committee A-Absorption, **M. F. Wirges,** Cities Service Oil Co., and **R. E. Styring, Jr.,** Atlantic Refining Co.; Sub-Committee B-Analysis, **A. J. Miller,** Phillips Petroleum Co., and **Fred Zapffo,** Lone Star Producing Co.; Sub-Committee C-Liquefied Petroleum Gasses, **R. R. Hawthorne,** Atlantic Refining Co., and **H. R. Thomas,** Stanolind Oil and Gas Co.; Sub-Committee D-Plant Control, **K. C. Bottenberg,** Phillips Petroleum Co., and **Carl Vickburg,** Carter Oil Co.

R. L. Johnson is now manager of Sunray Oil Corp.'s newly named refining and pipe line department, previously called the manufacturing, sales and pipe line department. Mr. Johnson was formerly manager of the refining division.

R. W. Griffith has been named as assistant manager of the new section.

Mr. Johnson has been with Sunray since 1928, holding a number of supervisory posts prior to his present promotion. Mr. Griffiith has been at Sunray since 1948.

Frank M. Perry, vice president in charge of natural gasoline and chemical operations for Cities Service Oil Co., has been appointed a member of the American Petroleum Institute's General Committee on Refining. Mr. Perry is the current president of the Natural Gasoline Association of America.

Norman E. Hathaway has received a six months' leave of absence from Davison Chemical Corp. to serve as director of the chemicals and rubber division in the now-being-formed successor agency to the National Production Authority.

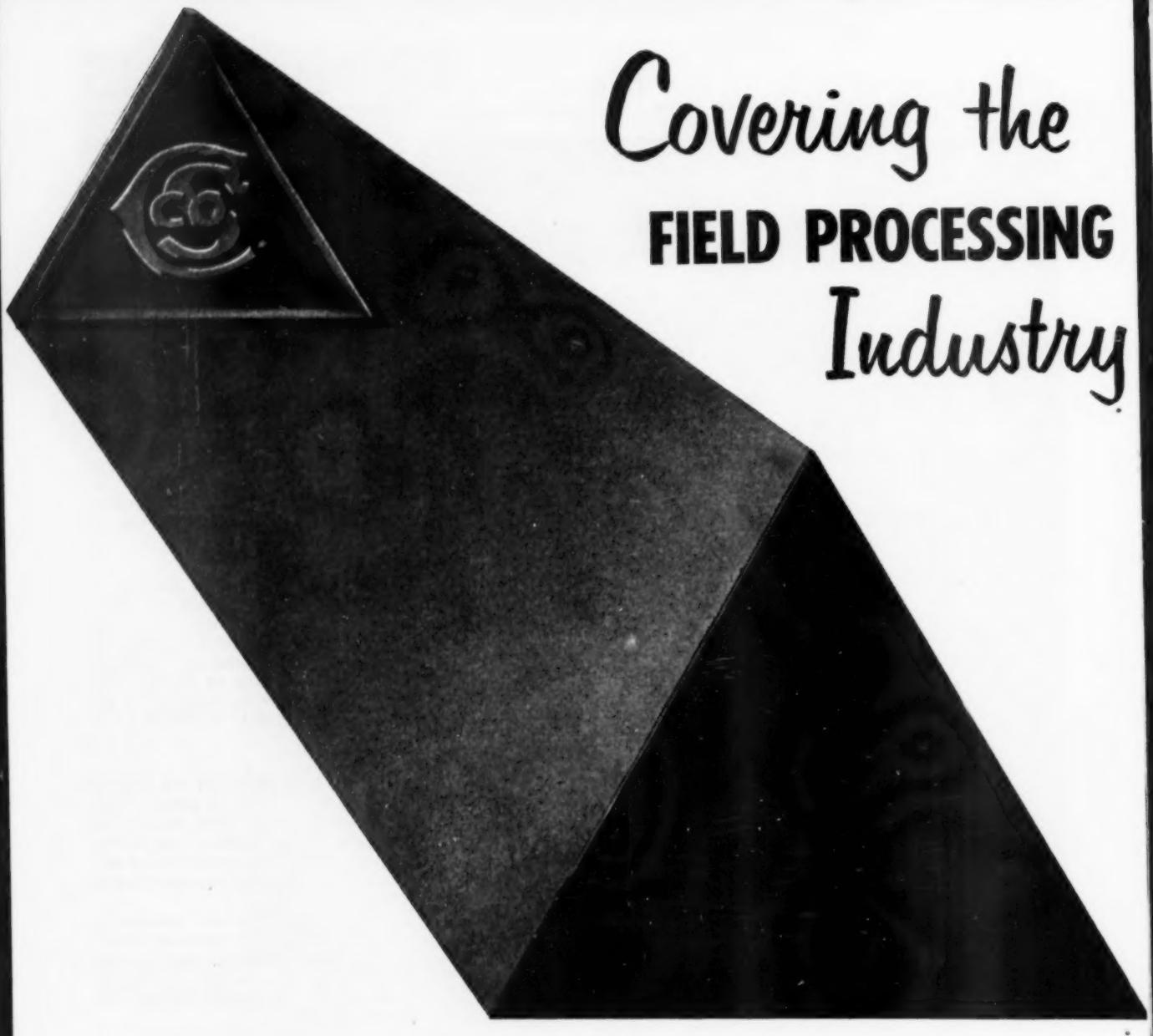
Mr. Hathaway is sales manager of Davison's industrial chemicals department. **David P. Barrett,** assistant sales manager in the same department, will assume Mr. Hathaway's duties while he is in Washington.

Marshall C. Freerks has been promoted to group leader in the research department of Monsanto Chemical Co.'s Organic Chemicals Division. Mr. Freerks has been with Monsanto since 1949, the same year in which he received his PhD in organic chemistry from the University of Minnesota.

Dr. R. S. Dicks has been named manager of the chemical process engineering section of Celanese Corp. of America's Textile Division.

Before joining Celanese in April, 1953, Dr. Dicks was senior process engineer of Shell Oil Co.

J. H. Cole has been named superintendent of the chemical division at Standard Oil Calif.'s Richmond re-



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THE CONTINENTAL SUPPLY COMPANY
General Offices: DALLAS, TEXAS
Representatives in All Principal Oil Fields of the World

SERVING THE OIL AND GAS INDUSTRIES

finery. He succeeds **L. L. Henning,** recently placed on special assignment.

D. K. Harger has been appointed general manager of Standard Oil Co. of Calif.'s El Segundo refinery, succeeding the late C. A. Pollard who died in August.

Mr. Harger

Mr. Harger, manager of operations at El Segundo since 1946, joined Standard in 1926 after his graduation from Stanford. In 1931 he was named foreman in charge of experimental laboratories, and in 1934 was transferred to the manufacturing department. He was named superintendent of process control at the Richmond, Calif. refinery in 1942.

Mr. Pollard was a 32-year Standard veteran and had been El Segundo refinery manager since October, 1951.

R. E. Luton has been named vice president in charge of refining of Ohio Oil Co., a newly-created office.

He was formerly manager of the refining division.

John H. Thacher has been elected a vice president of California Research Corp. He has been with Standard Oil Co. of Calif., Cal. Research's parent firm, since 1930.

Paul K. Doyle is now industrial relations supervisor at Union Oil Co. of Calif.'s research center, Brea, Calif.

Previously, he was assistant superintendent of personnel at Union's Los Angeles refinery at Wilmington.

James K. Small is the newly-appointed manager of Standard Oil Development Co.'s patent division. He was previously associate manager of the same division. He replaces former manager **Philip L. Young** who has been made secretary of the company.

Mr. Small received a degree in chemistry from MIT, and was admitted to the New York State Bar in 1939. He has been in Standard's patent division since 1934.

Dr. J. P. Coogan, head of the petroleum service department at Esso Standard Oil Co.'s Baton Rouge, La., refinery, has been transferred to the firm's Bayonne, N.J., refinery and will head the newly-formed technical department there.

A. W. Wood, technical assistant in the Bayonne process department, becomes head of the new process engineering division. **W. K. McOwen** becomes assistant head in that same division.

Esso Standard's new technical department at Bayonne will now be responsible for all laboratory studies, mechanical engineering, process engineering, economic study, cost analysis, metal inspection and other technical work performed in the refinery.

E. R. Herrick, manager of Heyden Chemical Corp.'s Fords, N.J., plant since 1940, has retired, and **Arthur W. Willis** has replaced him. Mr. Herrick will continue with the company in a consulting capacity.

Mr. Willis, who has specialized in improvement in processes for production of formaldehyde and hexamethylenetetramine, was formerly assistant manager of the firm's Princeton, N.J., facilities.

Harry F. Glair, director of purchases and long-time manufacturing executive of Standard Oil Co. (Ind.) retired in August.

Mr. Glair

Mr. Glair has been with Standard for 47 years. In 1914 he became assistant superintendent of the paraffin works at the Whiting, Ind. refinery. He was named assistant general superintendent of that refinery in 1921, general superintendent in 1927 and manager in 1929.

He was brought to the Chicago general offices in 1931 as assistant general manager of manufacturing, and became manager in 1933. A year later he was named to the firm's board.

Robert C. Gunness, assistant general manager of manufacturing, has been named to fill Mr. Glair's chair on the board of directors.

Elliott M. Harold is the new branch manager of Davison Chemical Corp.'s mixed fertilizer plant in New Orleans. He replaces **Henry Gaudet,** who retires as manager but remains as a consultant.

W. J. Birmingham has been appointed patent advisor in the Whiting, Ind., research laboratories of Standard Oil Co. (Ind.).

Mr. Birmingham recently was awarded his law degree from De Paul

what's NEW in Engineering

Laboratory facilities for engineering research are available to individuals and groups with worthwhile projects at Richmond Engineering Field Station, administered by Department of Engineering, University of California. Charges are based on actual expenditures with appropriate overhead. For information, write Institute of Engineering Research, University of California, Berkeley.

Rebuilding a near-ghost mine at Sunnyside, Utah, for greater coking-coal production with higher efficiency, is a current major project of Kaiser Engineers. The original Sunnyside mines, opened in 1896, were in bad condition. The problem was to rehabilitate and expand two existing

mines and open a third to raise coking coal production from 1,000,000 to 1,715,000 tons per year. We'll send you a reprint of an article by Wesley Hyatt and R. G. Heers in *Coal Age* which tells the full story of Sunnyside's emergence from a "near-ghost" to one of the most efficient and modern coal producers in the West.

A $50,000 bonus goes to the first person to bring in a Tennessee oil well that will produce 50 barrels a day for six months, according to a new state law. Only 35 wells are now producing in Tennessee, but geologists think the State has rich oil possibilities.

When it comes to research, preliminary engineering studies, engineering design and layout, estimating, preparation of specifications, construction programing, negotiation of contracts, and procurement and expediting of materials and equipment—call or write: Kaiser Engineers Division of Henry J. Kaiser Company, Kaiser Building, Oakland 12, California.

 (*To obtain more data on advertised products see page* 1584)

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WEATHERCOAT
Slows Weathering

WEATHER and WATER can't affect the protective qualities of Weathercoat: this tough ductile asphaltic coating *bridges* expansion, but remains firm under heat or cold.

That's why Weathercoat is preferred by most of the world's largest refineries* for protection of exposed insulation on fractionating columns, crude stills and tanks . . . for sealing insulation joints . . . exposed insulated pipelines . . . for membranes in reservoirs.

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Tucson, Ariz. Seattle, Wash. Baton Rouge 2, La. St. Louis 17, Mo. Inglewood, Calif.
Oakland 1, Calif. Portland 7, Ore. Washington 6, D. C. San Juan 23, P. R.

University, and is a mechanical engineering graduate of Stevens Institute of Technology. He also holds a master's degree in business administration from Harvard.

Vincent L. Rebak has been named New York district sales manager for Grace Chemical Co. At the same time **C. J. Bown** has been appointed Memphis district manager, and **D. Brittain Briggs** a technical manager in the company's nitrogen plant now under construction near Memphis.

William L. Fanning, Jr., has been promoted to products loss engineer with Tide Water Associated Oil Co.'s fire protection and safety department in New York.

Mr. Fanning first joined Tide Water Associated in 1946 as a process engineer at the firm's Bayonne, N. J., refinery.

Ferril M. Miller has been named resident plant engineer for Cities Service Oil Co.'s Chicago terminal and compound plant. He will also be in charge of the technical service department.

Roy Petterson succeeds Mr. Miller as resident chemist at the plant laboratory.

R. W. Van Tuyle has been named to the newly-established post of vice president in charge of manufacturing of Emery Industries, Inc.

Mr. Van Tuyle has been with the company for 19 years, most of that time as research director. In 1949, be became chemical director, in charge of all chemical engineering and experimental development activities.

Dr. John M. Butler and **Milton Kosmin** have been named section leaders in Monsanto Chemical Co.'s central research department.

Drs. Joseph E. Fields, Van R. Gaertner and **Robert J. Slocombe** have been named group leaders in the same department.

Dr. Butler received his PhD from Ohio State University in 1940. Mr. Kosmin received his master's degree from UCLA in 1948.

Emil S. Richter has been named superintendent of glycol-dichloride at Dow Chemical Co.'s Plant A in Freeport, Texas.

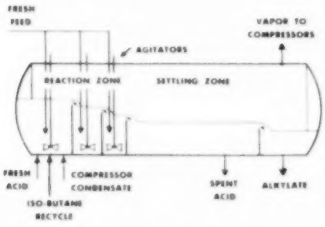
P. A. Horner is the new secretary of Shell Oil Co., replacing **F. W. Woods,** who has retired.

REFINERY PROCESS NEWS

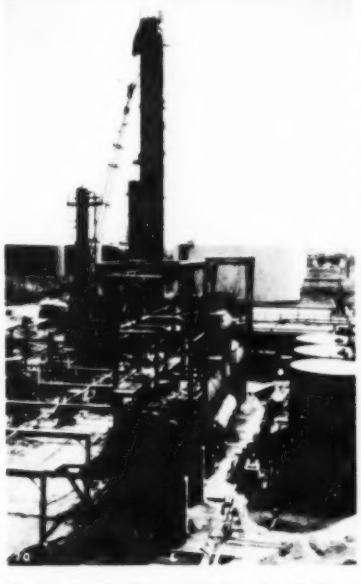
PUBLISHED BY REFINERY PROCESS DIVISION, THE M. W. KELLOGG COMPANY OCTOBER 1953

Another Alkylation Plant Well Underway

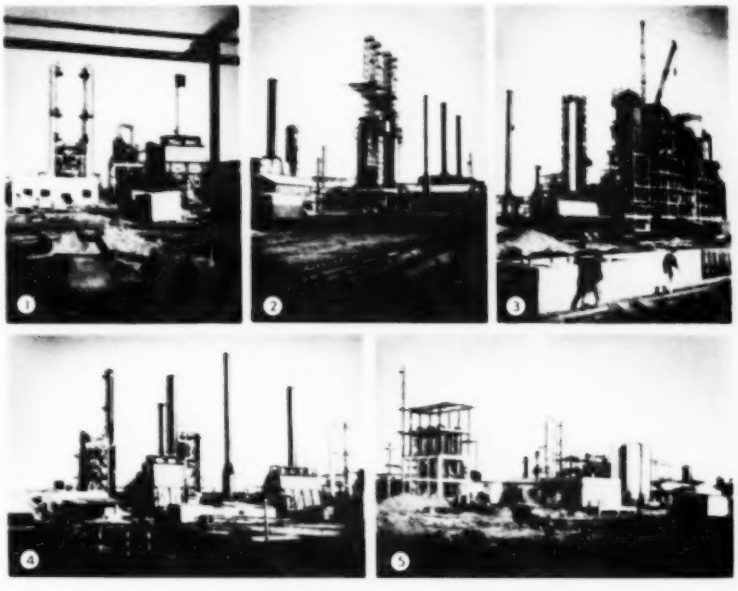
One of six Kellogg-designed alkylation units now in engineering or under construction, this one (see below) for a major East Coast refiner includes, as do the others, the unique Kellogg cascade reactor system, which has consistently produced the highest yield octane ratios at a minimum consumption of sulfuric acid.



Most important of the reasons for the improved efficiency of this new reactor is a design which provides for an unusually high isobutane-butylene ratio in the reaction phase. The reaction progresses most satisfactorily when the ratio is considerably in excess of the theoretical 4-1 ratio; Kellogg's design provides a 9-1 ratio without an increase in pumping or vessel costs.



Shown in the foreground is the Kellogg alkylation reactor. Large tower in the rear is the main isobutane-alkylate fractionator. The drums to the right are for sulfuric acid storage.



New Argentine Refinery Reflects Spread of U. S. Refining Techniques Abroad

One of six complete refineries now underway by Kellogg outside North America, this complete catalytic refinery for Yacimientos Petroliferos Fiscales in Argentina is indicative of the spread of modern U. S. refining techniques to countries which have been largely dependent upon imports to supply their needs for finished petroleum products. When on stream the new plant will have helped increase that country's domestic sources of refined oil by more than 30%.

It will be South America's most modern refinery in that it will contain most of the major catalytic processes currently employed to meet the high octane demands of the U. S. market.

Shown in the photographs are units for carrying out the eight principal processing steps to be included: (1) straight-run gasoline fractionation and vacuum distillation, (2) thermal cracking and delayed coking, (3) fluid catalytic cracking, (4) crude distillation, (5) catalytic polymerization and sulfuric acid alkylation. Not shown are product-treating units and the powerhouse.

Two indigenous crudes, Challaco and Comodoro Rivadaria, in a ratio of 25% to 75% respectively, will be charged to the refinery. Major final products will include nearly 2,500 BPD of aviation gasoline and more than 2,000 BPD each of diesel and fuel oil. The delayed coker, in preparing clean feed stock for the Fluid Catalytic Cracking Unit, will produce more than 600 tons of high quality coke daily.

One of Several Major Refinery Jobs in S. A.

This $70,000,000 Argentine refinery is only one of several major Kellogg projects currently underway in South America. These include two complete refineries of 5,000 BPD and 10,000 BPD capacities and nitrogen fertilizer facilities, at three different locations in Brazil, and a complete 20,000 BPD refinery in Chile.

In other parts of the world Kellogg projects include a complete 24,000 BPD thermal refinery in Iraq and a 70,000 BPD catalytic refinery for Australia, which will supply about 40% of that country's current product requirements.

(SEE REVERSE SIDE)

REFINERY PROCESS NEWS

CONTINUED FROM PRECEDING PAGE

Capacity of MWK Fluid Units Now Over Million BPD

The signing of several recent contracts for new Orthoflow Fluid catalytic crackers has brought the total fresh feed capacity of Kellogg-engineered FCCU's to well over 1,100,000 barrels per day. Included in this capacity are units ranging from 2,000 BPD to 63,000 BPD at locations all over the world.

When all these plants are operating, they will produce better than seven billion gallons of high quality motor gasoline annually or enough to provide every automobile in the world with an annual supply of about 100 gallons of gasoline.

One Out of Four Gallons From Kellogg Designed Units

The figures above refer only to the production of Kellogg Fluid catalytic cracking units and do not include the billions of gallons of gasoline being produced by other types of Kellogg designed plants. An indication of the total gasoline making capacity of all Kellogg plants is the fact that approximately one out of every four gallons of gasoline purchased in North America comes from plants built by Kellogg.

Europe, South America and Australia Adopt Fluid Process

It is well known that Fluid catalytic cracking dominates the gasoline industry today. In fact, approximately 63% of the world's catalytic cracking capacity is of this one type.

While this process has been dominant in domestic and Canadian refining since World War II, it is now beginning to play an increasingly important part abroad, where a number of leading refiners are installing catalytic crackers. Indicative of this is the fact that Kellogg has recently completed three fluid plants in the British Isles, is about to complete one in South America, and has started construction on still another as part of a complete refinery project in Australia. In continental Europe an Orthoflow Fluid catalytic cracker has just been completed and another is currently underway.

Two Big Cat Crackers in Philadelphia

This huge (63,000 BPD) Fluid catalytic cracking unit will soon be on stream. Workmen are already installing insulation on the towers of the plant's gas recovery section. (Below) At another site in Philadelphia construction of the largest Fluid catalytic cracker (45,000 BPD reactor throughput) yet to employ Kellogg's unique Orthoflow design is progressing rapidly.

"Why's" as Important as "How's" in Manuals

Although operating manuals are not as dramatic as the actual construction of a plant, properly prepared instructions on the functioning of a refining unit play a vital part in its eventual success.

This is particularly true of refineries outside the U. S. where design specialists are not always immediately available. But to do the job best, the manuals must go beyond explaining the various steps required to start up and operate a plant. They should also be a guide for understanding the overall process—not just the mechanics of running it. They should tell "why's" as well as the "how's."

The way these "why's" and "how's" are told is important. Kellogg is continuously working on the problem of condensing this material into its most convenient form without eliminating any necessary information.

For further information, technical data, etc., on any refining process, write

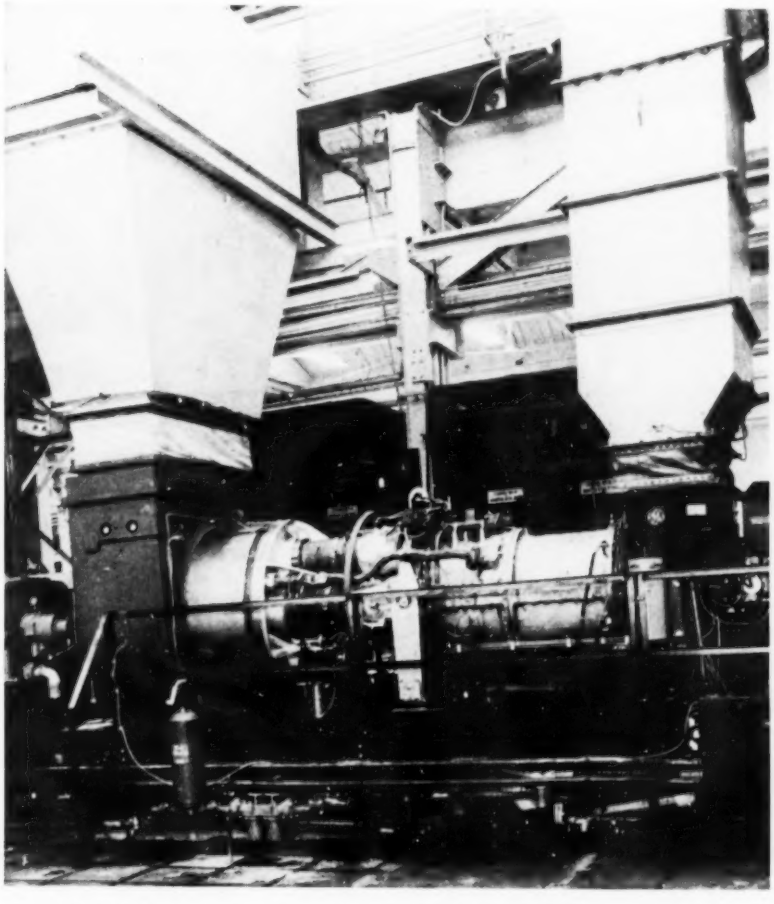
REFINERY PROCESS DIVISION

THE M. W. KELLOGG COMPANY

225 Broadway, New York 7, N. Y.

Also Jersey City, Los Angeles, Tulsa, Houston, Toronto, London and Paris

M. W. KELLOGG — A DIVISION OF PULLMAN



Gas Turbine Enters Petrochemical Picture

A gas turbine similar to the one pictured above will be used for the first time in the petrochemical industry at one of the major refineries of Esso Standard Oil Co.

The turbine, a General Electric product, will develop 5700 hp and drive a three-case 16-stage centrifugal compressor which compresses hydrocarbon gas from atmospheric pressure to approximately 285 psig. Turbine speed will be controlled throughout the normal operating range of 6400 rpm by means of a pneumatic controller which adjusts a fuel valve to maintain the desired compressor suction pressure. Using natural gas as fuel, the locomotive-type turbine will exhaust to a waste-heat boiler to produce process steam.

Monsanto Merges Sales Depts.

Two sales departments of Monsanto Chemical Co.'s Organic Chemicals Division have been combined into a single new department of petroleum chemicals and functional fluids sales. John W. Newcombe is manager of the new department.

Under the new system, the petroleum chemicals section will handle oil additives for specific automotive and industrial lubricant applications. The functional fluids section will be concerned with sales of nonflammable type hydraulic fluids for industrial applications.

New Bradford Research Head

J. N. Breston is Bradford Chemical Co.'s new director and vice president in charge of research and development.

He comes to Bradford from the Penn Grade Oil Association's research laboratory, where he has served as director since 1948. Prior to this work, Mr. Breston supervised petroleum refining research at Pennsylvania State College. He received his postgraduate education at that same school, taking his PhD in fuel technology.

Clark Establishes Scholarship

A $2,000 scholarship fund has been set up by Clark Equipment Co. at the Illinois Institute of Technology for students majoring in materials handling.

Known as the Eugene B. Clark scholarship, in honor of the company founder, the award will be made annually to a junior working for a degree in industrial engineering and majoring in materials handling. The grant will cover tuition costs for the student's final two years in school.

Scientific Names Brown

Scientific Design Co.'s new director of process development is David Brown. Mr. Brown, who received his master's degree in chemical engineering from MIT in 1940, previously was senior development engineer in Shell Development Co.'s process engineering department. Earlier, he served with M. W. Kellogg Co. and Standard Oil Co. of Calif.

Wagoner Is Multi-Amp VP

After 32 years with Westinghouse Electric Corp., J. L. Wagoner has joined Multi-Amp Corp. as vice president and national sales manager.

Mr. Wagoner will be responsible for building a national sales pattern for the various testing instruments manufactured by Multi-Amp.

Fawcett Fisher Research Director

J. S. Fawcett has been named director of the Fisher Scientific Co. development laboratories.

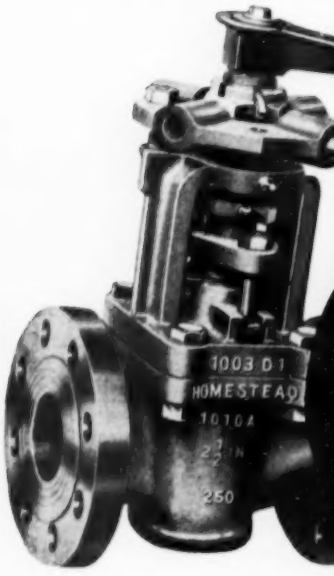
Before joining Fisher in 1951, he spent 12 years with Gulf Oil Co. research and development laboratories, where his special field was the new lubricating oils for industry.

Mr. Fawcett

For the past two years he has headed the Fisher-Tag division, directing re-design of the entire line of Tagliabue oil-testing instruments purchased by the company.

Mr. Fawcett is a member of the American Chemical Society and Com-

Where corrosion...temperature...pressure cause other valves to fail . . .



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Operate Instantly...Everytime...Anytime

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HOMESTEAD Lever-Seald PLUG VALVES are "Stick-Proof" because they're "Lever-Seald," which means that a powerful lever-and-screw device, built into every valve, assures positive action at all times under all conditions.

They operate fast, too—full open or closed by a quarter-turn; and because all operating parts are protected from line fluids, service conditions and weather, they last longer and cost less to maintain.

We make them in metals and alloys to suit your requirements in sizes 1½" to 12", for pressures from vacuum to 1500 lbs. and for temperatures ranging from 40° below zero to 1100° F.

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- Instant Stick-Proof operation.
- Quarter-turn fully opens or closes.
- Positive seal without lubrication.
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- Unobstructed straight-line fluid flow.
- All operating parts protected from damaging effects of service conditions and weather.

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HOMESTEAD VALVE MANUFACTURING COMPANY
"Serving Since 1892"
P. O. Box 43 Coraopolis, Pa.

mittee D-2 (Petroleum) of the American Society for Testing Materials.

Thomas New B&W GM

William J. Thomas, general sales manager, has been appointed general manager of the Tubular Products Division of Babcock & Wilcox Co., and Paul J. Utnehmer, works manager, has been named to the board of directors of that division.

Mr. Thomas

Mr. Utnehmer

Mr. Thomas has been with B&W since 1932. He was associated with the Boiler Division until 1941 when he left his position to join the Tubular Products Division. In 1948 he was named general sales manager. He is a mechanical engineering graduate of Carnegie Institute of Technology.

Mr. Utnehmer has been with the firm since 1945, and was named Beaver Falls works manager in 1948. He received his mechanical engineering degree at the University of Wisconsin in 1935.

Cameron Marley Co. VP

Marley Co. has named J. A. Cameron as executive vice president and assistant general manager.

Mr. Cameron

Mr. Cameron first joined the firm in 1937 as a sales engineer in the New York office. Two years later he was New York sales manager, and in 1944 became a vice president.

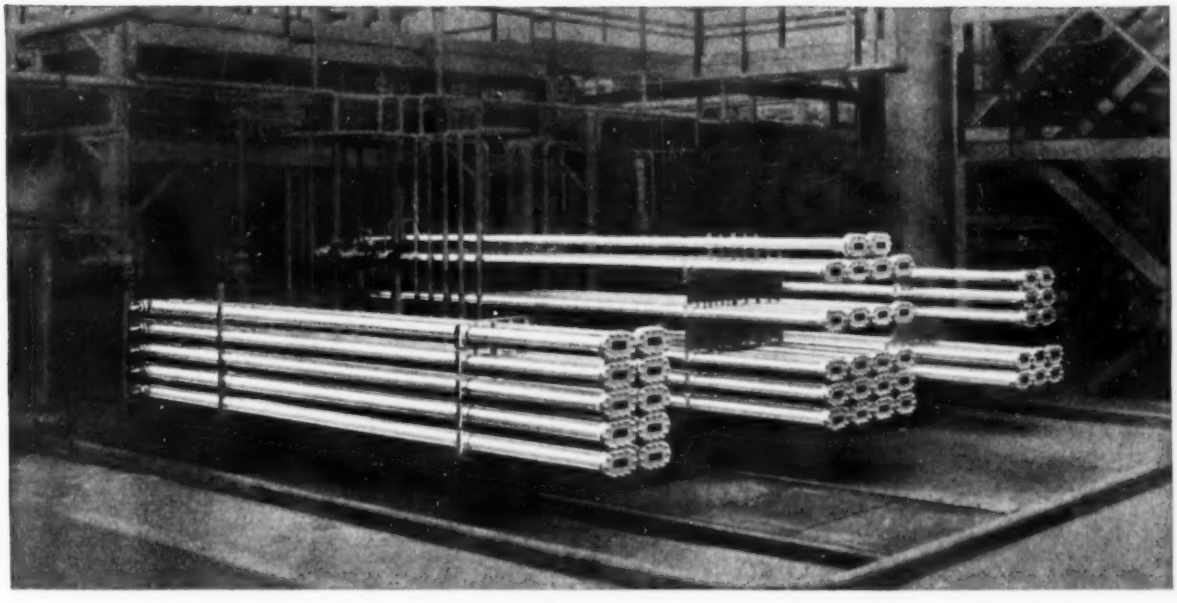
He received his mechanical engineering degree from Pennsylvania State College.

Superior Adds Vacuum Furnace

A vacuum furnace for annealing tubing of titanium and zirconium is being installed at the Norristown, Pa.,

Reduce Parts Inventories

in your plant with



BROWN FINTUBE *Sectional* HEAT EXCHANGERS

● When you install **different** types and sizes of specially designed, single purpose, heat exchangers in your plant, you have to buy separate sets of parts for **each** exchanger. These parts are costly; and there is the added expense of handling, and storing them.

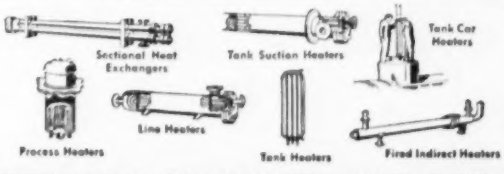
Unlike these fixed, specially built units, Brown Fintube heat exchangers consist of **Standard Sections** connected in proper series and parallel arrangement. Thus, only a small supply of parts are needed.

In the plant shown above, for example — different groups of Brown Fintube Standard Sections are handling 6 different heat transferring duties — and just a small handful of inexpensive parts serves as adequate stores for all 44 sections. In some cases Brown Fintube Standard Sections have reduced parts inventories **by as much as 82%**.

Reducing inventories is only one of Brown Fintube's many advantages. Our Bulletin 512 gives full details. Send for a copy. We can really save you money!

BROWN FINTUBE
HEAT TRANSFER PRODUCTS

BROWN FINTUBE CO.
Elyria, Ohio



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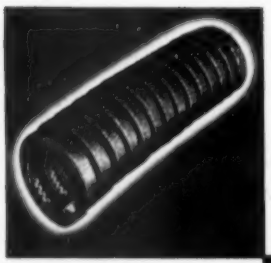
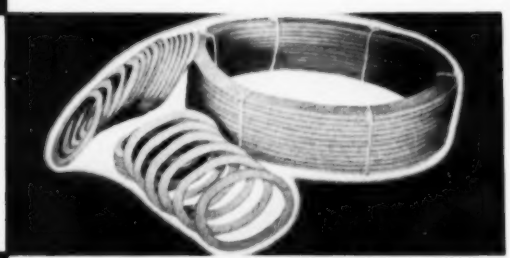
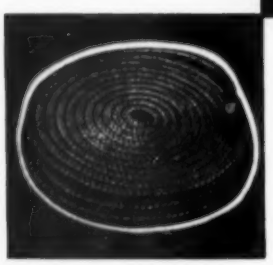
MEMPHIS • BIRMINGHAM • NEW ORLEANS • SHREVEPORT • TULSA • HOUSTON • DALLAS • DENVER • LOS ANGELES • SAN FRANCISCO • and ST. THOMAS, ONT.

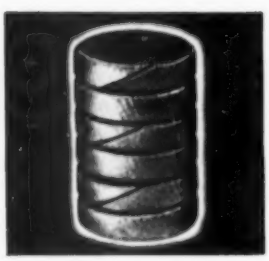
UNARCO



the name to look for in Packings and Gaskets







You pay very little for packings and gaskets, but failures always are costly. So it's wise to be sure you use the right type that's made to deliver long service.

When you ask for Unarco recommendations, or specify "UNARCO" Packings and Gaskets, you profit from a leader's 33 years experience as a basic manufacturer. As a basic manufacturer, we control the manufacture of UNARCO mechanical packings and gaskets from raw material to finished product. This assures the ultimate user of dependable manufacturing specifications.

To cut your maintenance and down-time . . . for welcome peace-of-mind . . . always insist on "UNARCO." Contact your nearby Unarco Distributor, or let us help solve your problems.

HIGH PRESSURE SPIRAL PACKINGS • SEMI-METALLIC PACKINGS • BRAIDED AND TWISTED PACKINGS • HAND-HOLE AND MANHOLE GASKETS • SHEET PACKINGS GASKET CLOTH • GASKET TAPE SPECIALTIES

UNARCO **UNION ASBESTOS & RUBBER COMPANY**

332 South Michigan Avenue • Chicago 4, Illinois

plant of Superior Tube Co. The batch type furnace can handle tubing in lengths up to 24 ft.

Superior Co. is putting up the equipment to help meet demand for its recently announced line of small titanium tubing.

Krans Trane New Lab Head

Donald H. Krans has been named by The Trane Co. to direct activities of its new research and testing laboratory now nearing completion.

Mr. Krans

Mr. Krans comes to Trane from the University of Illinois, where he was professor in charge of the University's heat power laboratory, teaching thermodynamics, heat transfer, refrigeration and power plant equipment. He holds a mechanical engineering degree from the University of Wisconsin.

According to company officials, the new lab will be the largest commercial operation of its type, being devoted to research in all phases of air conditioning, refrigeration, ventilation and heat transfer.

Personnel Changes

Geuder, Paeschke & Frey Co. — A. Neil Savee to sales manager of the steel package division from assistant sales manager.

Conoflow Corp.—Ralph G. Holben to plant manager from production manager; Horace C. Shuman, former assistant to Mr. Holben, to production manager; Harold W. Bonekat to purchasing agent.

Fischer & Porter Co.—Glen Dorflinger to district manager for the sale of process control instruments in Houston.

Norton Co.—Gerald H. Lusher to refractories engineer in a new company territory centering around Cincinnati and Louisville, Ky.

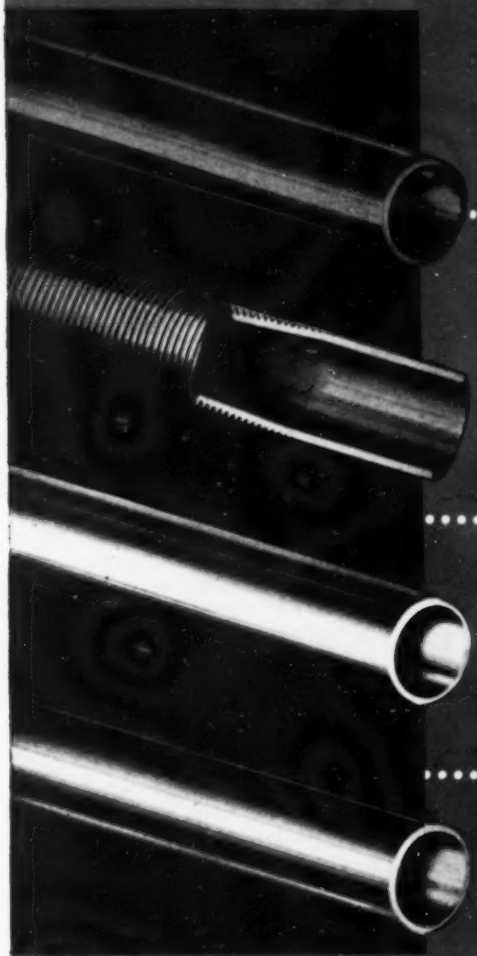
Hewitt-Robins, Inc.—Austin Goodyear to vice president from general manager of the rubber and conveyors division.

Oakite Products, Inc.—J. J. Basch to manager of research and product development from Philadelphia division manager.

(To obtain more data on advertised products see page 1584)

4 WOLVERINE PRODUCTS for Processors

PRIME EXAMPLES OF TUBEMANSHIP AT WORK!



. . . PRIME SURFACE OR PLAIN CONDENSER TUBE

Wolverine condenser tube of copper and copper-base alloy is produced under the type of control that gives real meaning to the word Tubemanship. Which, in turn, is just another way of saying Wolverine is backed by over thirty-seven years' experience in the manufacture of all kinds of tubing. Wolverine produces plain condenser tube in sizes ranging from ½" to 2" O.D.

. . . FINNED CONDENSER TUBE—TRUFIN*

Wolverine Trufin—the integral finned tube—provides the following advantages: (1) more compact, economical heat exchanger or condenser unit design, (2) can be assembled, rolled or brazed into headers by conventional methods, (3) in many applications, can greatly increase capacities of existing units, (4) can be directly substituted for prime surface condenser tubes.

Trufin is made in a wide range of sizes for shell and tube units. Trufin is available in copper, copper-base alloys, aluminum, carbon and stainless steel, as well as in bi-metal.

. . . ELECTRIC-WELDED STEEL TUBE

Here again, Wolverine Tubemanship pays off. The same attention to detail, the same quality control standards which have been built up as a result of thirty-seven years of tube-making—combine to produce a dependable new product: Wolverine electric-welded steel tube. Wolverine electric-welded steel tube is produced in sizes ranging from ¼" through 3" O.D.—and in the following analyses: SAE 1010, SAE 1012, SAE 1020, SAE 1025, SAE 1030.

. . . ALUMINUM TUBE

Aluminum tube, too, is another product of Tubemanship. You can get it in 25 and 35 aluminum and in standard sizes from ½" through 2" O.D. Wall thicknesses range from .020 through .180. Remember that Wolverine makes Trufin of aluminum or bi-metal—aluminum with a copper lining.

IMPORTANT! Next time any questions arise regarding tubing or its application to your particular problem—just give Wolverine's Technical Sales Department a call. There's no obligation. No cost. In the meantime, write us for an informative, free booklet covering the products which interest you.

WOLVERINE TUBE DIVISION
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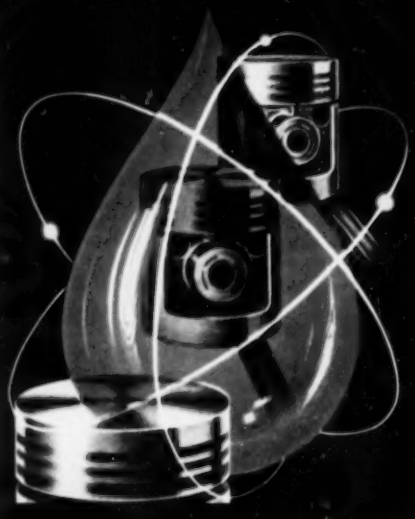
Plants in Detroit, Mich. & Decatur, Ala. *Sales offices in Principal Cities*

*REG. U. S. PAT. OFF.
Wolverine Trufin and the Wolverine Spun End Process available in Canada through the Unifin Tube Co., London, Ontario.

Radioactivity used to prove superiority of



Oronite Lube Oil Additives

Oronite, a major producer of Lube Oil Additives, employs advanced radioactive tracer techniques to achieve superior performance from the Additives it markets.

You will also find Oronite Additives offer important savings in treating costs because of the high quality detergent and inhibitor chemicals from which they are made. And you can always be sure of uniformity in your finished oils.

Why not talk your problems over with us? An Additive specialist will call on you on request. Phone or write the nearest Oronite office.

ORONITE CHEMICAL COMPANY
THE NAME TO WATCH IN CHEMICALS

With Oronite Additives you can formulate oils to meet the new A. P. I. Service Classifications and can meet specifications for 2-104-B, MIL-O-2104, Supplement 1 and Series II oils.

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600 S. MICHIGAN AVENUE, CHICAGO 5, ILL.
MERCANTILE SECURITIES BLDG., DALLAS 1, TEXAS

Suppliers

S. Morgan Smith Co.—David W. Hopkins to chief consultant of the firm's valve division.

Bristol Co.—D. C. Sanford to manager of the application engineering department.

Durametallic Corp. — Joseph H. Leath to the Houston sales and service office.

Electro Rust-Proofing Corp.—R. J. Fitzgerald to district manager of the company's Middle Atlantic States Division.

Franklin Supply Co. — William Kerin, Jr., to district sales manager, Oklahoma City, from same position at Mt. Pleasant, Mich.

Branches, Distributors

Clark Equipment Co.'s southeastern regional sales office has moved from Norfolk, Va., to 161 Spring Street Bldg., Atlanta, Ga.

Dowell, Inc., has opened a new sales and service office in Depew, N.Y.

Davis Instruments, division of Davis Emergency Equipment Co., has named Industrial Scientific, Inc., as their representative in Texas, southern Louisiana and parts of New Mexico.

Tube Turns, Inc., has established a branch plant in Houston to make possible quick delivery of products to the southwest's petroleum industry.

Radiant Combustion System, Inc., has appointed W. P. Iverson & Co. as general sales agents for the company's products.

Expansion, Transition

Carlon Products Corp. has completed construction of a plant in Klamath Falls, Oregon, for the manufacture of plastic pipe. Production began September 1. This brings to seven the number of Carlon plants now operating in the U. S.

Walker Process Equipment, Inc., has completed its new plant facilities, which include offices, laboratories and manufacturing departments under one roof. Walker manufactures and supervises installation of process equipment to handle industrial liquids, water treatment, sewage and waste treatment.

(*To obtain more data on advertised products see page* 1584)

Proceedings of Combustion Symposium Held At M.I.T. in 1952 Are Released

Fourth Symposium (International) on Combustion, held at Massachusetts Institute of Technology, September 1-5, 1952, published by the standing committee on Combustion Symposia; 7 x 10 in., xx + 926 pp., stiff cloth binding, $7.00. The Williams & Wilkins Co., Baltimore, Md.

ALTHOUGH space limitations prevented printing of the entire record of this Fourth Symposium on Combustion, the record recently released gives a full summary of all papers and discussions.

Emphasis at this meeting was placed on the physical aspects of combustion, particularly wave phenomena and turbulence, treated from both experimental and theoretical standpoints. Thus many papers submitted on the chemical kinetics of combustion processes were not accepted. It's hoped, however, that this subject can be included in a future symposium.

Included in the contents are several papers each on flammability, ignition, theoretical and experimental studies on laminar combustion and detonation waves, cellular flames and oscillatory combustion, turbulent flames, quenching, flash back and blow off, flames of fuel jets, burning of fuel droplets and combustion in rockets and engines. Material from each of the 112 papers presented is found in the book. The author's list contains an imposing list of U. S. and foreign chemical authorities.

The book itself is an unusually well-produced technical text. Type is large and easily readable, and formulas and equations are clearly delineated. Many graphs and photographs are used to supplement the printed material. Editing of papers shows good organization, and each subject is followed with a long list of references. Addition of a subject index, however, would have been a help.

Review of Petroleum Technology in 13th Edition

Reviews of Petroleum Technology, Vol. 13, edited by George Sell; 6 x 9 in., viii + 360 pp., indexed, stiff cloth cover. The Institute of Petroleum, 26 Portland Place, London, England.

THIS 13th volume in the series of annual reviews on the progress of petroleum technology covers developments during 1951. In its 21 chapters are some 3,000 references to articles which appeared in technical publications during the review period.

The text itself discusses in summary what has been happening in each particular field, giving a general picture of advancements made. Frequent numerical annotations refer to a list at the end of each chapter which gives exact references for statements made. Included are data on chemical and physical refining, catalytic cracking, distillation, plant instrumentation, analysis and testing, lubricants and many other subjects of interest to the refinery or process engineer. In some cases, the literature reviewed covers somewhat more than that published in 1951.

API Book Discusses Waste Water Analysis

THE American Petroleum Institute has published a fourth volume in its manual on disposal of refinery wastes.

This latest book, entitled "Sampling and Analysis of Waste Water," discusses the latest procedures for dealing with effluent waters from refinery operations. It brings up to date some material originally contained in Vol. 1. It is bound in loose-leaf form for easy revision as new procedures are available.

Methods discussed in detail in Vol. 4 include collection and preservation of samples, spot samplers and their use, automatic compositing samplers, absolute density of waste water, absolute viscosity of waste water and many other factors in pollution control.

Price of Vol. 4 is $5.00. Orders should be sent to J. A. McNally at API's headquarters at 50 W. 50th St., New York 20, N. Y.

Handbook Gives Physical Constants on Solvents

The Handbook of Solvents, by Leopold Scheflan and Morris B. Jacobs; 6½ x 9½ in., 704 pp., stiff cloth cover, $10.00. D. Van Nostrand Co., Inc., 250 Fourth Ave.,

THIS book gives the physical properties on 2740 liquid solvent compounds. It's divided into 2 sections, the first dealing with the theoretical and practical attributes of solvents, and the second giving physical properties.

In the first part such factors as solvent action, solvent power, vapor pressure, evaporation and evaporation rates, dilution ratios and limits of inflammability are discussed. In the second part, listings for individual solvents include such physical data as formula, formula weight, characteristics, melting point, boiling point and range, specific gravity, etc. All of the constants available for a given compound are listed directly under that compound for easy reference. Where literature records more than one value for a constant, all values are listed. When available, values of constants at different temperatures are given.

A comprehensive list of synonyms is given in a table. Thus it is still easy to find a compound even if only the synonym is known.

Report on Cathodic Protection with Zinc

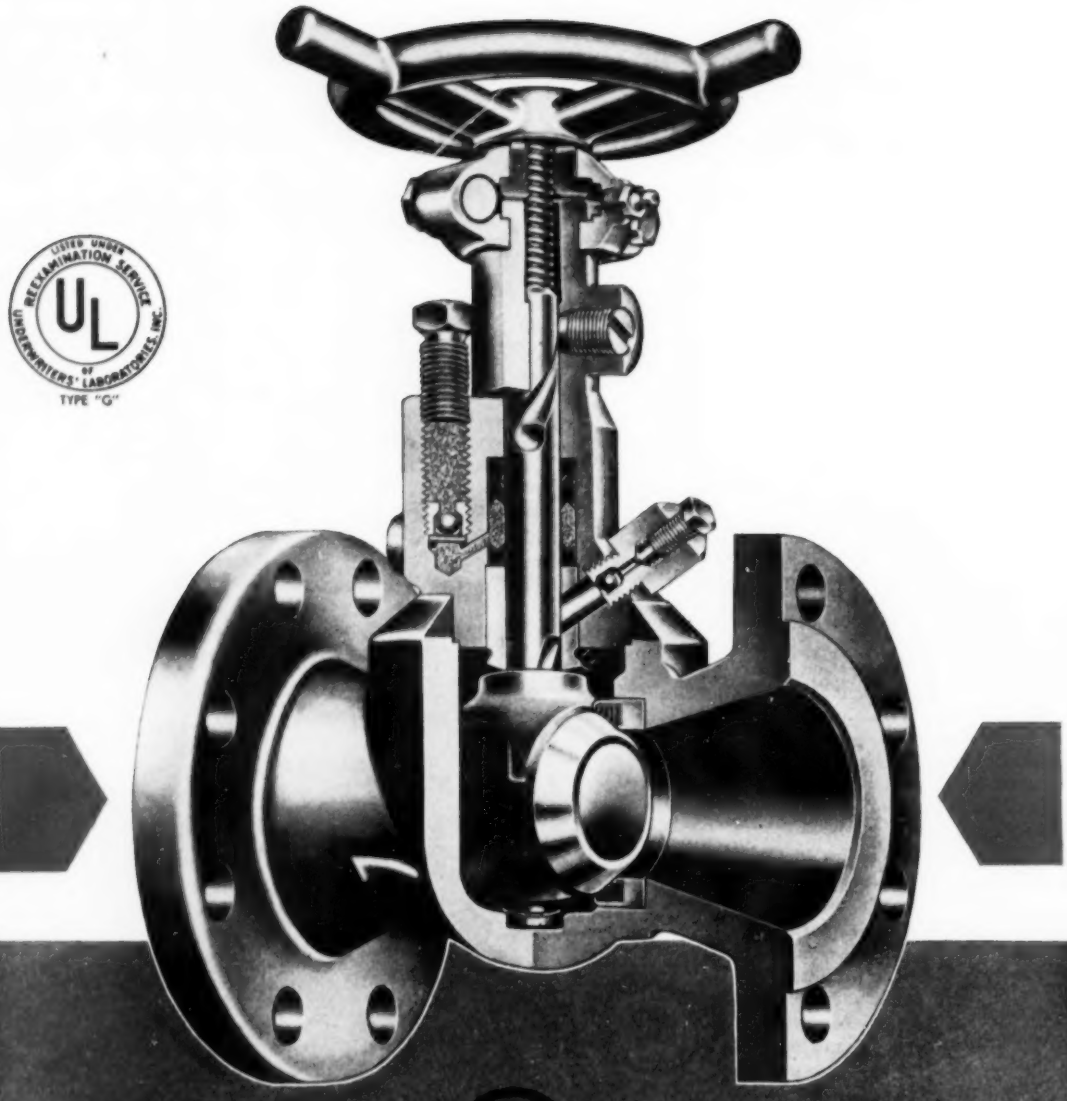
WHILE zinc has been used for cathodic protection for 100 years or more, recent expansion of use in underground and underwater installations has prompted intensive studies of the subject, and this report prepared by Ebasco Services, Inc., for the American Zinc Institute.

Sections include data on corrosion of underground structures and cathodic protection, properties of zinc anodes, cathodic protection of steel distribution piping systems, heat exchangers and condensers, water storage tank risers, zinc anode protection on old lines, etc.

The report is intended to supplement the report entitled "Zinc as a Galvanic Anode" published by AZI in 1951. A section of graphs and illustrations is included, which show anode life under varying conditions, and give information on proper installation. Copies may be obtained free of charge from the American Zinc Institute, 60 E. 42nd St., New York 17, N. Y.

Release '53-54 Government Organization Manual

THE U. S. National Archives and Records Service has just published a government organization manual for 1953-54. It lists the divisions and departments of the legislative, judicial and executive branches, as well as the numerous appointed agencies and commissions. Copies are $1.00 each, and can be obtained by writing the Superintendent of Documents, Government Printing Office, Washington 25, D. C.



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forged Steel VENTURI VALVES

If you are planning new plant construction or an expansion program to increase your output of Petroleum Hydrocarbons you will be needing Valves.

Use ORBIT LP-GAS VALVES. They are competitively priced besides offering low cost maintenance, dependable operation and positive Friction-Free closure.

ORBIT LP-GAS VALVES are available in both Venturi and Full Round Opening Type. Venturi Type furnished in Flanged End only, Ring Joint and Raised Face. Full Round Opening Type in both Screw End and Flanged End. Carbon Trim or Stainless Trim. Maximum Rated Working Temperature 250° Fahr. *Write for Prices and Specifications.*

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AIEE Fall Conference Will Feature Electrical Problems in Petroleum

THREE sessions of the fall general meeting of the American Institute of Electrical Engineers, to be held at the Hotel Muehlebach, Kansas City, Mo., Nov. 2-6, will be devoted to electrical applications in refining and in pipe line transmission of natural gas and oil.

Eight papers by electrical engineers who are specialists in this field have been scheduled for the sessions. They are:

Natural Gas Plant Power Distribution Systems, by C. D. Catt, El Paso Natural Gas Co., and J. K. Howell, Westinghouse Electric Corp.

Distribution Systems in Oil Refineries, by T. R. Shaw, Phillips Petroleum Co.

Selection of Motors and Controls for Pipe Line Pumping Stations, by R. J. Osborn, Sinclair Pipe Line Co.

Automatic and Remote Control of Electric Pipe Line Stations, by R. S. Cannon, Plantation Pipe Line Co.

Petroleum Microwave Progress, 1950-1953, by E. B. Dunn, Keystone Pipe Line Co.

Application of Outdoor Metalclad Switchgear, by E. R. Hoyle, Sinclair Refining Co.

Protection of Large Motors, by Carl R. Olson, Westinghouse Electric Corp.

Oil versus Air Circuit Breakers for Petroleum Refineries, by W. B. Wilson, and J. Erwin, General Electric Co.

An additional paper of interest to refiners will be presented by W. M. Rust of Humble Oil & Refining Co. during a session of radio communication systems. His paper is entitled: Use of Radio and Radar in the Petroleum Industry.

Texas AIChE to Hold 8th Technical Meeting

MORE than 500 are expected to attend the 8th annual technical meeting of the South Texas Section, American Institute of Chemical Engineers, at Galveston on October 16.

Four sessions will highlight the get-together, including one on industrial organic chemistry and another on economics and cost estimating.

Resources Conference Set For Washington in Dec.

RESOURCES for the Future, Inc., says a conference on natural resources problems and outlooks will be held in Washington, D. C., December 2-4. Named to the steering committee on conference preparation was C. I. Weaver, Ohio Fuel & Natural Gas Co.

Cecil Morgan, Standard Oil Co. (N. J.), represented the American Petroleum Institute at an organizational meeting.

Oil Show to be Held Again in 4 or 5 Years

WILLIAM B. WAY, general manager of the recent International Petroleum Exposition at Tulsa, says he believes the next show will be held in four or five years. No date will be set for about two years, at which time the executive committee of the show's board of directors will review industry's opinion.

AIChE New Yorkers Have Management Talk

AN all-day symposium on management, new construction materials and solids handling will be conducted by the New York section of the American Institute of Chemical Engineers on October 22 at Hotel New Yorker, New York City.

Among topics to be discussed in the management meeting are financing chemical expansion, management controls, maintenance, materials handling and utilization of personnel.

The Oil Man's Calendar

OCTOBER

Scientific Apparatus Makers Assn., mid-year meeting of the recorder-controller section Seaview Country Club, Absecon, N. J., Oct. 14-16.

American Institute of Chemical Engineers, South Texas Sections, 8th annual technical meeting, Galveston, Texas, Oct. 16.

Society of Industrial Packaging and Materials Handling Engineers, exposition technical short course and competiton. Mechanics Hall, Boston, Mass., Oct. 18-24.

American Institute of Chemical Engineers, New York Section, symposium on management, new construction materials, solids handling, Hotel New Yorker, New York City, Oct. 22.

Western Petroleum Refiners Ass'n, regional meeting, Garrett Hotel, El Dorado, Ark., Oct. 22-23.

Natural Gasoline Ass'n of America, regional meeting, Blackstone Hotel, Tyler, Texas, Oct. 24.

National Lubricating Grease Institute, annual meeting, Edgewater Beach Hotel, Chicago, Ill. October 26-28.

Association of Consulting Chemists and Chemical Engineers, annual meeting (25th anniversary), Hotel Belmont-Plaza, New York City, Oct. 27.

NOVEMBER

Packaging Association of Canada, annual convention, Toronto, Nov. 1-7.

American Oil Chemists Society, fall meeting, Sherman Hotel, Chicago, Nov. 2-4.

American Institute of Electrical Engineers, fall general meeting, Hotel Muehlebach, Kansas City, Nov. 2-6.

Society of Automotive Engineers, national fuels and lubricants meeting, Conrad Hilton Hotel, Chicago, Nov. 5-6.

American Petroleum Institute, annual meeting, Conrad Hilton Hotel and Palmer House, Chicago, Nov. 9-13.

National Ass'n. of Corrosion Engineers, 1953 Fall Conference of Western Region, Biltmore Hotel, Los Angeles, Nov. 19-20.

Natural Gasoline Ass'n of America, regional meeting, Herring Hotel, Amarillo, Texas, Nov. 21.

Chemical Industries Exposition, Commercial Museum and Convention Hall, Philadelphia, Pa., Nov. 30-Dec. 5.

DECEMBER

Chemical Specialties Manufacturers Ass'n, Annual meeting, Mayflower Hotel, Washington, D. C., Dec. 6-8.

Scientific Apparatus Makers Ass'n, laboratory apparatus, laboratory equipment and optical sections mid-year meeting. Boca Raton Club, Boca Ration, Fla., Dec. 7-10.

American Chemical Society, regional conclave. Juug Hotel, New Orleans, La., Dec. 10-12.

American Institute of Chemical Engineers, annual meeting, Hotel Jefferson, St. Louis, Mo., Dec. 13-16.

American Chemical Society, 1953 Symposium on "Flow Through Porous Media," University of Michigan, Ann Arbor, Dec. 28-29.

JANUARY, 1954

Plant Maintenance and Engineering Show, International Ampitheatre, Chicago, Ill., Jan. 25-28.

Society of Automotive Engineers, annual meeting and engineering exhibit, Sheraton-Cadillac and Statler Hotels, Detroit, Mich., Jan. 11-15.

American Institute of Electrical Engineers, winter general meeting, Statler Hotel, New York City, Jan. 18-22.

MARCH

American Society for Testing Materials, spring meeting, Hotel Shoreham, Washington, D. C., March 1-5.

National Ass'n. of Corrosion Engineers, 10th annual conference and exhibition, Kansas City Municipal Auditorium, Kansas City, Mo., March 15-19.

MAY

American Petroleum Institute, Division of Refining, 19th mid-year meeting, Rice Hotel, Houston, Texas, May 10-13.

Is Thruput your problem?

A 30% to 100% increased thruput is no problem with Koch "Benturi" Kaskade trays. The inherent design of "Benturi" trays makes the greatest possible use of available slot energy forces. This is why almost 37% of all "Benturi" installations have been replacements for conventional bubble trays. Wire, write or phone us on the application of "Benturi" trays to your problem; no obligation.

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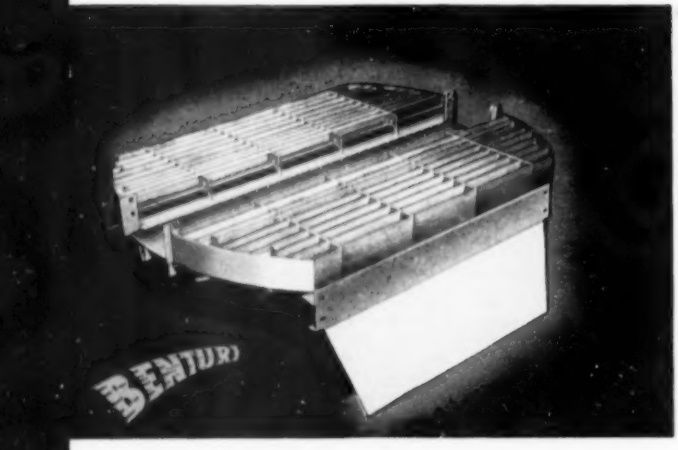

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British Associates
Messrs. A. F. Craig & Co., Ltd.
Paisley, Scotland

Runs to Stills Slow to Come Down Despite Announcements of Cuts

Outlook: No general curtailment in runs to stills is expected to follow the reductions made by a few companies. . . . A few plants may find their product storage tanks brimming before the heavy withdrawals of heating oils start, but these will be isolated instances. . . . Motor fuel demand is holding up at a rate that makes it look like the early forecasts for 1954 will have to be revised upward.

Though more warning signals are flying, indications late in September were that the scale of refinery operations will continue at a rate that will hold total inventories of product stocks at high levels, rather than reducing them.

The Texas Railroad Commission has made a further reduction in the state's allowable for October, based on the oil cmpanies' revised nominations. The cuts over two months amount to 200,000 b/d, and the current total allowable is 2,904,409 bbls. Oklahoma authorities have cut that state's allowable output for the latter part of September by 20%, to a total of 432,000 b/d.

The reductions in crude runs announced in September by a few oil companies amount to a total of around 185,000 b/d, and some 25,000 bbls. more is to be effective in October and through the fourth quarter. The effect on overall crude runs was hardly discernable, the total being 7,136 b/d avg. for the first three weeks of the month.

Gasoline: Indicated demand for gasoline for 8 months is at a rate 10% higher than for the same period in 1952, and signs point to its continuing to hold up at a rate higher than expected. The earlier forecasts placed 1953 demand at not over 6% higher than the year before, so it is possible the industry may have to revise upwards its ideas of what 1954 gasoline demand will be.

Gasoline stocks at refineries, the middle of September, were around 143,500,000 bbls. for the U. S., 22.3% higher than on a comparable date in 1952. In California stocks were 45% larger; east of California stocks on Sept. 12, of 122,760,000 bbls., were 19.1% greater. Reductions in stocks during August and the first three weeks of September were only nominal. This condition existed in 1952 and, east of California particularly, stocks actually increased in these same weeks. The past two years have reversed the former practice of the industry, which was to pull on stocks at the rate of around 1,000,000 bbls. a week during this period.

The largest increases in stocks over a year ago, except for California, are in the interior districts and the Gulf Coast.

Heating Oils: Primary inventories of heating oils (kerosine and distillates) east of California on Sept. 12 were 147,624,000 bbls., 12.2% larger than on Sept. 13, '52. This is a sizeable increase but it will be taken up in part when secondary suppliers come into the market to build up their inventories against the coming winter's needs. They have held off thus far because of the uncertain condition of the market. Stocks of heating oils by refinery districts are detailed in Table 1. The report on secondary stocks as of July 31, the latest available, shows the total for kerosine and distillate fuels, 23,009,000 bbls., was 10% lower than on the same date a year ago. In the near future, these suppliers not only must bring their inventories up to the normal figure, but they must also prepare for around an 8% increase in heating oil consumption this winter. The buildup in refinery storage of heating oils in August, and thus far in September this year, is very close in volume to that of a year ago, which indicates the secondary suppliers so far have been holding off building up their stocks. There is ample secondary storage available.

Residual Fuels: The only refinery product where demand (4.2% increase over '52 for 8 months) is greatly ahead of supply (2% gain over 8 months of '52). Current stocks are several million barrels less than a year ago.

Fig. 1—No Drop in Early Sept. Runs

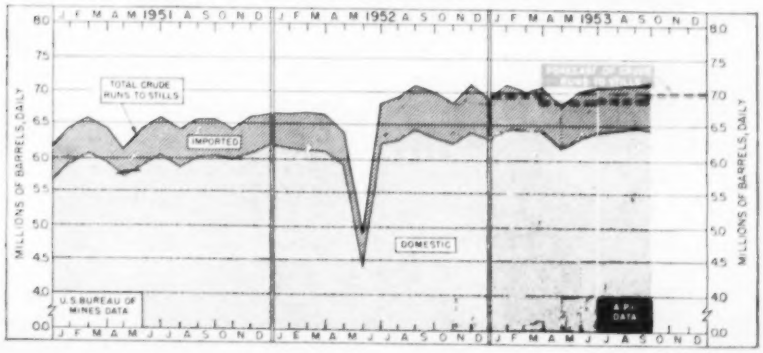


Table 1—Refinery Stocks of Heating Oil (Distillate and Kerosine) by Refinery Districts Sept. 13, '52 and Sept. 12, '53

(Thousand barrels, API Data)

	Sept. 12, '53	Sept. 13, '52	Change Amount	%
East Coast	33,748	30,153	+ 3,595	11.9
Gulf Coast	26,524	21,968	+ 4,556	20.8
Total Coastal	60,272	52,121	+ 8,151	15.6
Appalachian	4,969	5,229	— 260	5.0
Ind.-Ill.-Ky.	29,114	24,626	+ 4,488	18.2
Okla.-Kans.-Mo.	14,959	11,283	+ 3,676	32.5
Other Inland	13,446	9,770	+ 3,676	37.5
Total Inland	62,488	50,908	+11,580	22.7
Total East of Cal.	122,760	103,029	+19,731	19.1
California	20,727	14,267	+ 6,460	45.3
Total U.S.	143,487	117,296	+26,191	22.3

Crude Runs to Stills

Daily Average (1000 bbls.)

	Domestic	Foreign	TOTAL
Sept. '53 API*	6,425	711	7,136
Sept. '52 BM	6,358	659	7,017
Change	+67	+52	+119
% Change	1.0	8.0	1.7

* Through Sept. 19

Total (1000 bbls.)
(Bureau of Mines Data)

8 Mos. '53*	1,550,209	154,899	1,705,108
8 mos. '52	1,460,250	130,181	1,590,431
Change	+89,959	+24,718	+114,677
% Change	6.1	19.0	7.2

*July & Aug. estimated from API data.

BM Data on Crude Runs to Stills, 1953
(July 30, 1953; 1000 b/d avg. by quarters)

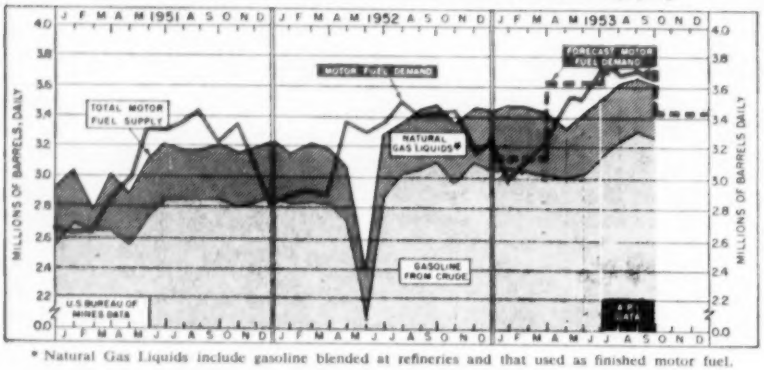
Actual	Estimated		Forecast	
1st Q. 7,006	2nd Q. 6,959	3rd Q. 6,991	4th Q. 7,044	

Yields on Crude Runs to Stills

	Gasoline %	Kerosine %	Dist. Fuels %	Resid. Fuels %
Sept. '53 API*	45.7	4.4	20.1	17.6
Aug. '53 API	46.3	4.5	20.3	17.3
July '53 API	45.7	4.7	20.5	17.6
Sept. '52 BM	43.9	4.9	21.2	17.4

* Through Sept. 19

Fig. 2—Small Drop in Motor Fuel Supply


J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
J F M A M 1953 A S O N D
MILLIONS OF BARRELS, DAILY
TOTAL MOTOR FUEL SUPPLY
MOTOR FUEL DEMAND
FORECAST MOTOR FUEL DEMAND
NATURAL GAS LIQUIDS*
GASOLINE FROM CRUDE
U.S. BUREAU OF MINES DATA
A.P.I. DATA

* Natural Gas Liquids include gasoline blended at refineries and that used as finished motor fuel.

Fig. 3—No Withdrawals from "Gasoline" Stocks

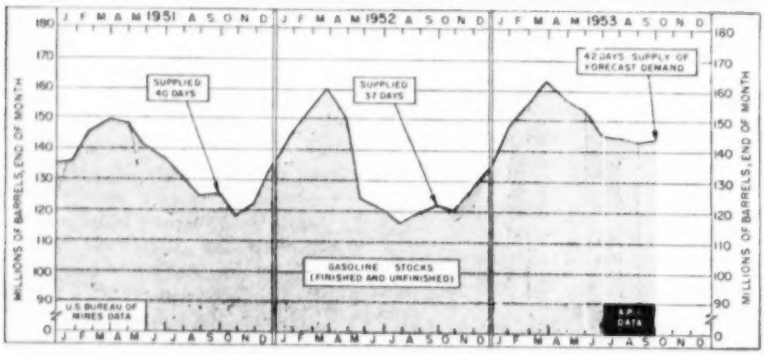

J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
J F M A M 1953 A S O N D
MILLIONS OF BARRELS, END OF MONTH
SUPPLIED 40 DAYS
SUPPLIED 37 DAYS
42 DAYS SUPPLY OF FORECAST DEMAND
GASOLINE STOCKS (FINISHED AND UNFINISHED)
U.S. BUREAU OF MINES DATA
A.P.I. DATA

Fig. 4—Slight Upturn in Heating Oil Demand

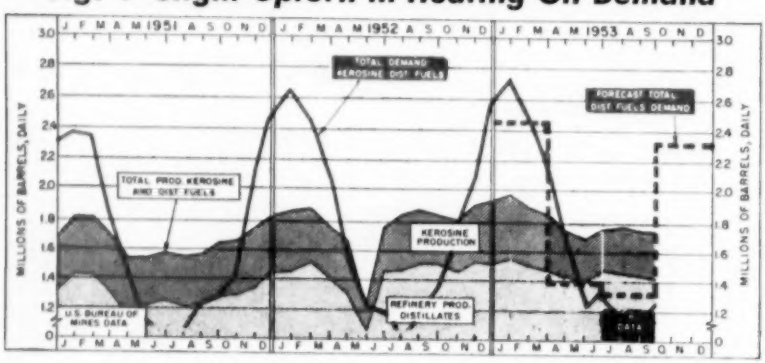
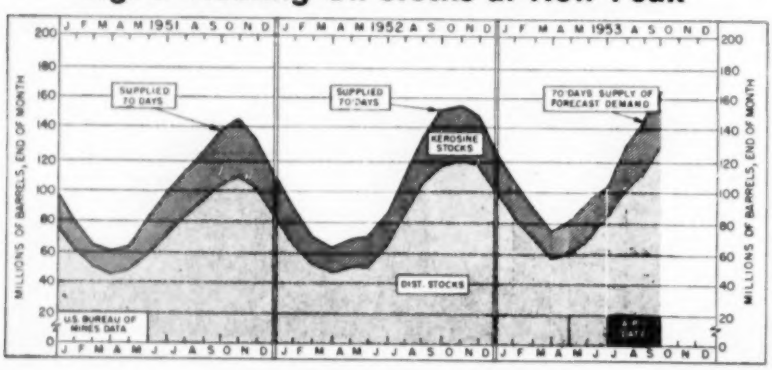

J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
J F M A M 1953 A S O N D
MILLIONS OF BARRELS, DAILY
TOTAL DEMAND, KEROSINE DIST. FUELS
FORECAST TOTAL DIST. FUELS DEMAND
TOTAL PROD. KEROSINE AND DIST. FUELS
KEROSINE PRODUCTION
REFINERY PROD. DISTILLATES
U.S. BUREAU OF MINES DATA
A.P.I. DATA

Fig. 5—Heating Oil Stocks at New Peak


J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
J F M A M 1953 A S O N D
MILLIONS OF BARRELS, END OF MONTH
SUPPLIED 70 DAYS
SUPPLIED 70 DAYS
70 DAYS SUPPLY OF FORECAST DEMAND
KEROSINE STOCKS
DIST. STOCKS
U.S. BUREAU OF MINES DATA
A.P.I. DATA

Motor Fuel Supply

Daily Average (1000 bbls.)

	Gasoline from Crude	Natural Blended Used Direct	TOTAL
Sept. '53 API*	3,260	370	3,630
Sept. '52 BM	3,122	377	3,499
Change	+138	−7	+131
% Change	4.4	1.8	3.8

* Through Sept. 19

Total (1000 bbls.)
(Bureau of Mines Data)

8 Mos. '53*	760,530	90,707	851,237
8 Mos. '52	677,918	90,687	768,605
Change	+82,612	+20	+82,632
% Change	12.2		10.7

*July & Aug. estimated from API data.

Motor Fuel Demand

Including Exports
Daily Average (1000 bbls.)

Sept. '53 API*	3,620
Sept. '52 BM	3,427
Change	+193
% Change	5.6

* Through Sept. 19

Total (1000 bbls.)
(Bureau of Mines Data)

8 Mos. '53*	843,984
8 Mos. '52	785,023
Change	+58,961
% Change	7.5

*July & Aug. estimated from API data.

BM Data on Motor Fuel Demand, 1953
(July 30, 1953; 1000 b/d avg. by quarters)

Actual	Estimated	Forecast	
1st Q. 3,150	2nd Q. 3,610	3rd Q. 3,674	4th Q. 3,435

Gasoline Stocks

Finished and unfinished, end of month (1000 bbls.)

Sept. '53 API*	143,740
Aug. '53 API	143,548
July '53 API	143,426
Sept. '52 BM	129,991

* Sept. 19

Heating Oils Production

(Kerosine and Distillates)
Daily Average (1000 bbls.)

	Kero-sine	Dist. Fuels	TOTAL
Sept. '53 API*	316	1,434	1,750
Sept. '52 BM	350	1,502	1,852
Change	−34	−68	−102
% Change	10.0	4.4	5.4

* Through Sept. 19

Total (1000 bbls.)
(Bureau of Mines Data)

8 Mos. '53*	86,883	355,982	442,865
8 Mos. '52	86,030	338,950	424,980
Change	+853	+17,032	+17,885
% Change	1.0	5.0	4.2

*July & Aug. estimated from API data.

Heating Oils Demand

Daily Average (1000 bbls.)

	Kero-sine	Dist. Fuels	TOTAL
Sept. '53 API*	195	1,011	1,206
Sept. '52 BM	263	1,077	1,340
Change	−68	−66	−134
% Change	25.8	6.1	10.0

* Through Sept. 19

Total (1000 bbls.)
(Bureau of Mines Data)

8 Mos. '53*	79,028	339,665	419,693
8 Mos. '52	80,717	324,836	405,553
Change	−1,689	+14,829	+13,140
% Change	2.1	4.6	3.2

*July & Aug. estimated from API data.

BM Data on Heating Oils Demand, 1953
(July 30, 1953; 1000 b/d avg. by quarters)

Actual	Estimated	Forecast	
1st Q. 2,459	2nd Q. 1,398	3rd Q. 1,283	4th Q. 2,321

Heating Oil Stocks

(1000 bbls. end of month)

	Kero-sine	Dist. Fuels	TOTAL
Sept. '53 API*	37,358	126,189	163,547
Aug. '53 API	35,061	118,158	153,219
July '53 API	30,672	102,002	132,674
Sept. '52 BM	35,021	117,252	152,273

* Sept. 19

Fig. 6—Residual Fuel Output Steady

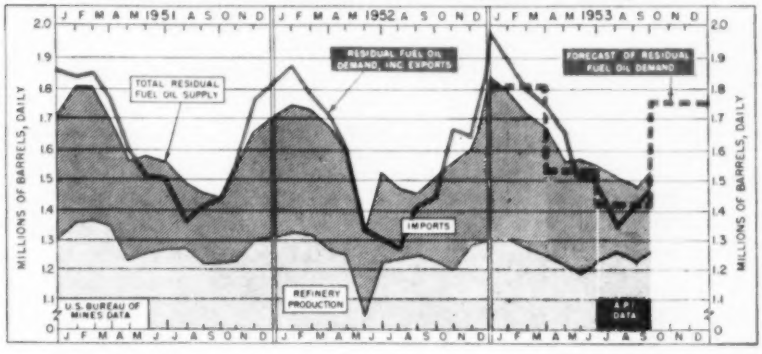
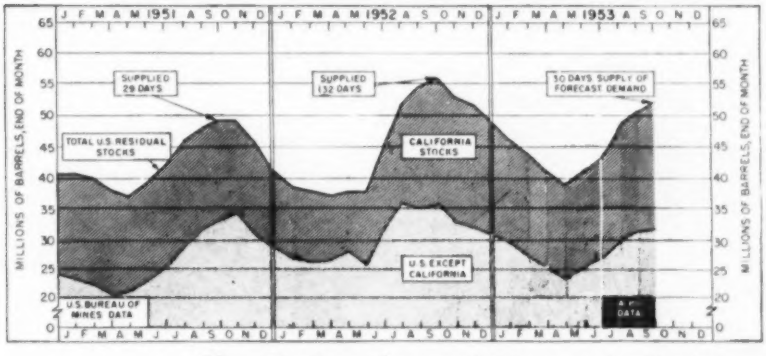

MILLIONS OF BARRELS, DAILY
J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
J F M A M 1953 A S O N D
TOTAL RESIDUAL FUEL OIL SUPPLY
RESIDUAL FUEL OIL DEMAND, INC. EXPORTS
FORECAST OF RESIDUAL FUEL OIL DEMAND
IMPORTS
REFINERY PRODUCTION
U.S. BUREAU OF MINES DATA
A.P.I. DATA

Fig. 7—U. S. Residual Stocks Climbing


MILLIONS OF BARRELS, END OF MONTH
J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
J F M A M 1953 A S O N D
SUPPLIED 29 DAYS
SUPPLIED 132 DAYS
50 DAYS SUPPLY OF FORECAST DEMAND
TOTAL U.S. RESIDUAL STOCKS
CALIFORNIA STOCKS
U.S. EXCEPT CALIFORNIA
U.S. BUREAU OF MINES DATA
A.P.I. DATA

Residual Fuels Production

Daily Average (1000 bbls.)

	Refinery Output	Imports	TOTAL
Sept. '53 API*	1,257	290	1,547
Sept. '52 BM	1,230	289	1,519
Change	+27	+1	+28
% Change	2.2		1.8

* Through Sept. 19

Total (1000 bbls.)
(Bureau of Mines Data)

8 Mos. '53*	303,163	88,150	391,313
8 Mos. '52	301,241	82,272	383,513
Change	+1,922	+5,878	+7,800
% Change	0.6	7.1	2.0

*July & Aug. estimated from API data.

Residual Fuels Demand

(Daily Average (1000 bbls.)

Sept. '53 API*	1,482
Sept. '52 BM	1,464
Change	+18
% Change	1.2

* Through Sept. 19

Total Demand (1000 bbls.)

8 Mos. '53*	392,396
8 Mos. '52	376,623
Change	+15,773
% Change	4.2

*July & Aug. estimated from API data.

BM Data Residual Fuels Demand, 1953
(July 30, 1953; 1000 b/d avg. by quarters)

Actual	Estimated	Forecast	
1st Q. 1,833	2nd Q. 1,542	3d Q. 1,429	4th Q. 1,763

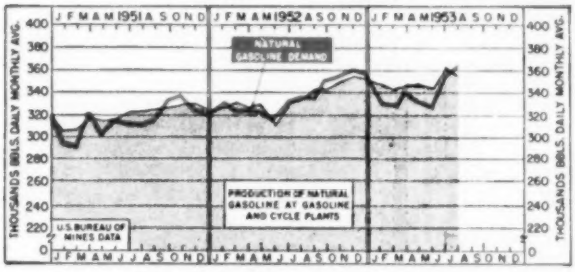
Residual Fuels Stocks

1000 bbls. end of month

	U.S. Except California	TOTAL U.S.
Sept. '53 API*	31,966	52,164
Aug. '53 API	31,370	50,926
July '53 API	30,128	49,453
Sept. '52 BM	36,566	56,200

* Sept. 19

Fig. 8—Supply and Demand of Natural Gas Liquids


THOUSANDS BBLS. DAILY MONTHLY AVG.
J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
J F M A M 1953 A S O N D
NATURAL GASOLINE DEMAND
PRODUCTION OF NATURAL GASOLINE AT GASOLINE AND CYCLE PLANTS
U.S. BUREAU OF MINES DATA

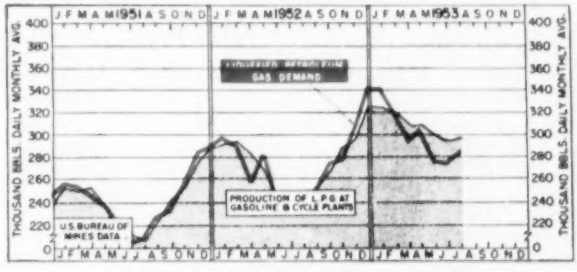
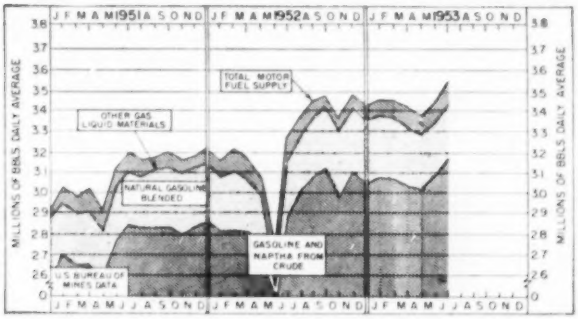

THOUSAND BBLS. DAILY MONTHLY AVG.
J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
J F M A M 1953 A S O N D
LIQUEFIED PETROLEUM GAS DEMAND
PRODUCTION OF L.P.G. AT GASOLINE & CYCLE PLANTS
U.S. BUREAU OF MINES DATA

Fig. 9—Makeup of Motor Fuel Supply


MILLIONS OF BBLS. DAILY AVERAGE
J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
J F M A M 1953 A S O N D
TOTAL MOTOR FUEL SUPPLY
OTHER GAS LIQUID MATERIALS
NATURAL GASOLINE BLENDED
GASOLINE AND NAPTHA FROM CRUDE
U.S. BUREAU OF MINES DATA

(Figures in table in 1000 bbls./day average)

	Gasoline & Naphtha from Crude	Natural Blended	Other Gas Liquid Materials	Total Motor Fuel Supply
June '53	3,168	298	99	3,565
May '53	3,100	266	93	3,459
July '52	3,012	283	93	3,388

Natural Gas Liquids Statistics

(Source: U.S. Bureau of Mines Report on Natural Gasoline and Cycle Plant Operations)

	Supply* (1000 bbls./day avg.) Natural Gasoline	LPG	TOTAL	Demand** (1000 bbls./day avg.) Natural Gasoline	LPG	TOTAL
July '53*	11,109	9,223	20,332	11,325	8,799	20,124
July '52	10,344	7,498	17,842	10,444	7,352	17,796
Change	+765	+1,725	+2,490	+881	+1,447	+2,328
% Change	7.4	23.0	13.8	8.4	19.5	13.1
	Total Supply (1000 bbls.)			Total Demand (1000 bbls.)		
7 Mos. '53*	73,980	65,236	139,216	72,842	63,848	136,690
7 Mos. '52	69,788	56,801	126,587	69,727	55,326	125,053
Change	+4,194	+8,435	+12,629	+3,115	+8,522	+11,637
% Change	6.0	14.8	10.0	4.5	15.4	9.3

Stocks, End of Month (1000 bbls.)

	By type of product (At gasoline plants and terminals only) LPG	Natural Gasoline	Condensate	Finished Gasoline†	By Location Gasoline Plants	Refineries	Total
July '53	3,579	3,310	260	1,041	8,250	3,003	11,253
June '53	3,155	3,602	255	1,030	8,042	3,012	11,054
May '53	2,808	3,411	237	1,195	7,641	2,718	10,359
July '52	2,747	2,738	259	1,134	6,878	3,217	10,095

*Supply includes receipts from refineries as well as current production from natural gasoline and cycling plants. Receipts from refineries in July included 240,000 bbls. of natural gasoline.

**Demand does not include liquefied refinery gases produced for fuel and chemical purposes which totaled 2,750,000 bbls. in July.

†Includes naphtha and other products.

Information Offered in the Advertisements

Do you need detailed information on a specific subject? Check through this easy-to-use index of literature and data being offered in this issue's advertisements.

ADDITIVES, for oil burners: Technical bulletin 0-87; Monsanto Chemical Co. See adv't p. 1495.

ADSORBENTS, fullers earth and activated bauxites: Information; Attapulgus Minerals & Chemical Corp. See adv't p. 1607.

AIR PREHEATERS: Information; The Air Preheater Corp. See adv't p. 1489.

ANALYZERS, infrared: Bulletins on three models; The Perkin-Elmer Corp. See adv't p. 1446.

BLENDERS, continuous: Descriptive literature; % Proportioneers, Inc.% See adv't facing p. Inside Front Cover.

BURNERS, fuel oil, gas: Detailed information: National Airoil Burner Co., Inc. See adv't p. 1605.

CATALYTIC REFORMING: Booklet on Atlantic "Catforming"; The Atlantic Refining Co. See adv't pp. 1500-1501.

CLEANERS, hydraulic jet type: Literature; Sellers Injector Corp. See adv't p. 1609.

DRIERS, for instrument air: Booklet "Because Moisture Isn't Pink"; The Pittsburgh Lectrodryer Corp. See adv't p. 1468.

ELECTRICAL SYSTEMS: Information; Westinghouse Electric Corp. See adv't pp. 1502, 1503, 1597.

FIRE PROTECTION, all types: Bulletin 66, "The ABC of Fire Protection"; Automatic Sprinkler Corp. of America. See adv't p. 1596.

FIRE PROTECTION, by foam system: Data sheet 53-3-A; National Foam System, Inc. See adv't p. 1455.

FITTINGS, welded: Catalog W-3; Bonney Forge & Tool Works. See adv't p. 1461.

FLOW METERS, Facts on "Xacto"; Bowser, Inc. See adv't p. 1609.

FLOW METER, and controller: Bulletin 125; Askania Regulator Co. See adv't p. 1613.

FLOW METER, system for automatic batching: Bulletin F1-49; Hetherington & Berner, Inc. See adv't p. 1605.

GAS ANALYSIS APPARATUS: Burrell Gas Analysis manual and catalog No. 81; Burrell Corp. See adv't p. 1601.

GASHOLDERS: Complete facts; General American Transportation Corp. See adv't pp. 1434-1595.

GEAR DRIVE, right angle: Catalog and Engineering data; Johnson Gear & Mfg. Co. See adv't p. 1556.

HEAT EXCHANGERS: Information; American District Steam Co., Inc. See adv't p. 1478.

INHIBITOR, corrosion resistant, for tanks, lines and vessels: Samples and literature; Universal Oil Products Co. See adv't pp. 1462-1463.

INSULATION, asbestos - cement: Data book on roofing and siding; The Philip Carey Mfg. Co. See adv't p. 1542.

INSULATION, finishing cement, quick setting: Details; The Philip Carey Mfg. Co. See adv't p. 1542.

INSULATION, magnesia block, pipe coverings and cements: Magnesia data book; The Philip Carey Mfg. Co. See adv't p. 1542.

INSULATION, mineral wool cement: Data book MW-50; The Philip Carey Mfg. Co. See adv't p. 1542.

INSULATION, Weather resistant: Catalog; Insul-Mastic Corp. of America. See adv't p. 1479.

LEVEL GAGE, for tanks, electronic: Bulletin CP-3004; The Vapor Recovery Systems Co. See adv't p. 1594.

LIFT TRUCKS, side loading: Descriptive Bulletin; The Baker-Raulang Co. See adv't p. 1471.

LIQUID LEVEL GAGES, convex scale, remote readings: Complete data; Jerguson Gage & Valve Co. See adv't p. 1558.

MIST ELIMINATORS, knitted wire mesh: Catalog; Metal Textile Corp. See adv't p. 1436.

PACKING, and seals: Bulletin No. DMPP; Durametallic Corp. See adv't p. 1608.

PAINT, corrosion resistant: Booklet; U. S. Stoneware Co. See adv't p. 1488.

PAINT, rust preventive: Complete literature; Rust-Oleum Corp. See adv't p. 1561.

PROCESS EQUIPMENT, and engineering services: Catalog RC-8523; The Fluor Corp., Ltd. See adv't p. 1481.

PROCESS HEATERS: Full details; Selas Corp. of America. See adv't p. 1474.

PROCESS, by Perco: Full information; Phillips Petroleum Co. See adv't p. 1459.

PUMPS, positive displacement, triplex plunger type: Complete information; Oil Well Supply Division, U. S. Steel Corp. See adv't p. 1433.

REFRACTORIES, specially engineered: "Basic Materials" booklet; Norton Co. See adv't pp. 1450, 1451.

REFRACTORY LININGS, hydraulic setting: Brochure RC-28A; Johns-Manville. See adv't p. 1600.

SAFETY HEAD, with rupture disc: Complete catalog; Black, Sivalls & Bryson, Inc. See adv't p. 1448.

STEAM TRAPS, general: Bulletin 853; W. H. Nicholson & Co. See adv't p. 1604.

TANK CLEANING, with chemicals: Handbook; Oakite Products, Inc. See adv't p. 1610.

TEMPERATURE LIMIT SWITCH, explosion-proof: Catalog - G-18; Burling Instrument Co. See adv't p. 1605.

TUBE CLEANER, and expanders: Details; Airetool Mfg. Co. See adv't p. 1560.

TUBING, alloy: Detailed technical data bulletin TB-6; The Babcock & Wilcox Co. See adv't p. 1453.

VALVES, control, direct and reverse acting: Bulletin 700-2; Minneapolis-Honeywell Regulator Co. See adv't pp. 1469, 1476, 1477.

VALVES, diaphragm control: Valve engineering data catalog, Bulletin CV-53; Kieley & Muller, Inc. See adv't p. 1599.

VALVES, forged steel venturi type: prices and specifications; Orbit Valve Co. See adv't p. 1576.

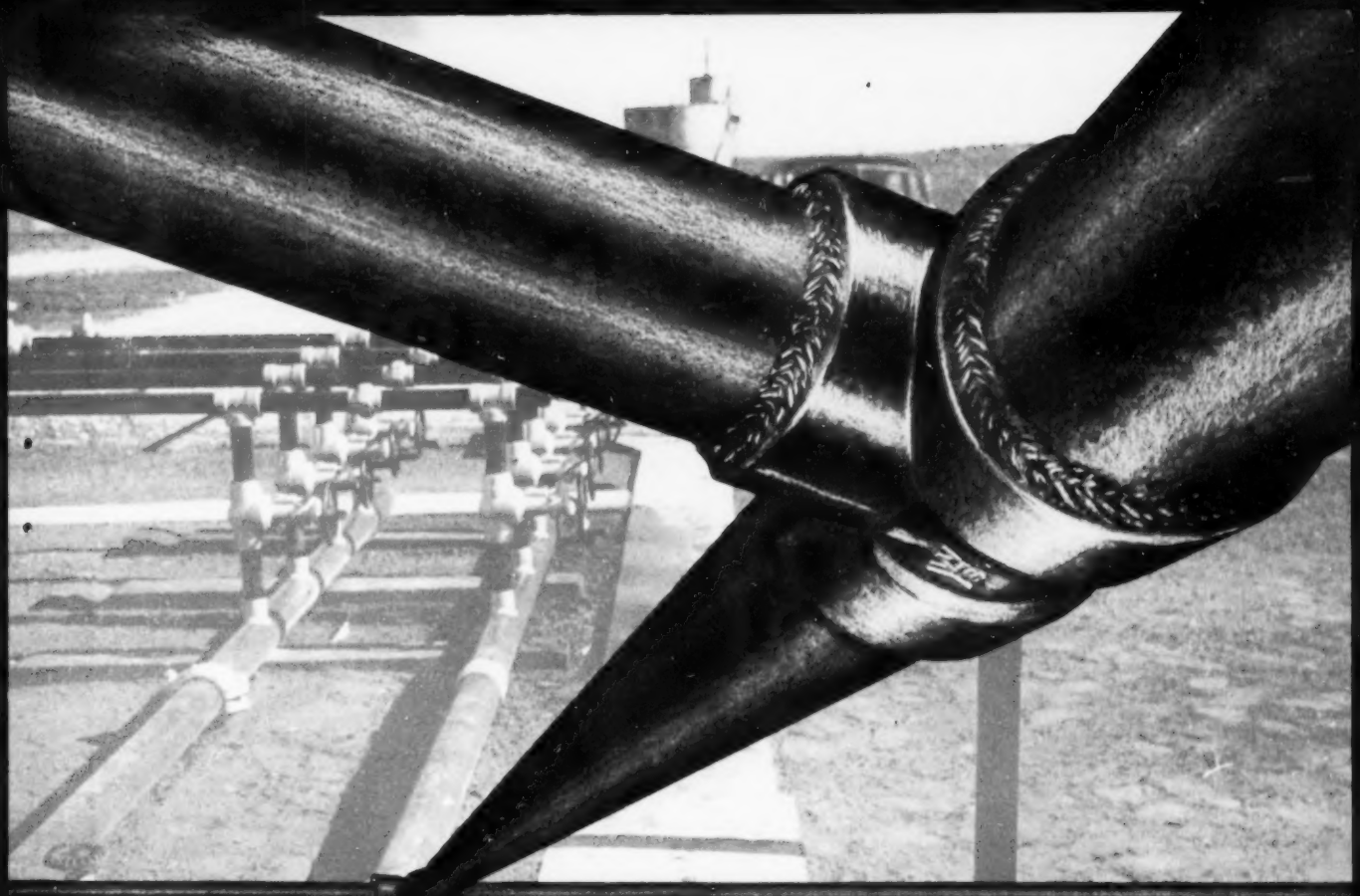
VALVES, gate: Crane catalog; Crane Co. See adv't p. 1454.

VALVES, gate, forged steel: Catalog 10; The Chapman Valve Mfg. Co. See adv't p. 1494.

VALVES, lubricated plug: Catalog PV-2; The Wm. Powell Co. See adv't p. 1497.

VALVES: Sizing calculator: Kieley & Muller, Inc. See adv't p. 1599.

WATER SEPARATORS: Process manual R-101-53; Warner Lewis Co. See adv't p. 1609.



Forged to Fit Petroleum Problems . . .

WATSON-STILLMAN SOCKET-WELDING FITTINGS

Have you discovered the economy and low maintenance cost of an all-welded piping system? If so, you are already in line for still further advantages from this type of system when you start specifying Watson-Stillman Double-diamond FORGED STEEL SOCKET-WELDING FITTINGS.

Made on special machines from solid forgings whose material is selected for good weldability and in strict accordance with the required specifications.

W-S Fittings give you joints stronger than the pipe itself. Deep sockets, ease alignment, provide ample come and go for pipe sections, minimize field cutting and assembly problems.

Design of fitting is such that flow is smooth and uninterrupted by "icicles" or turbulence at the joint. Available in carbon, stainless and chrome-moly alloy steels.

For those applications where screw-end fittings are indicated, you can get the same superior physical and chemical qualities in the steel analyses you want by specifying W-S FORGED STEEL SCREW-END FITTINGS. Look for the double-diamond trademark. Write for literature.

SOLD THROUGH LEADING DISTRIBUTORS

WATSON-STILLMAN FITTINGS DIVISION

H. K. PORTER COMPANY, INC.

129 ALDENE RD., ROSELLE, NEW JERSEY

907

ADVERTISER'S INDEX

FOR INFORMATION ON ANY PRODUCT OR SERVICE ADVERTISED IN THIS ISSUE SEE INSTRUCTIONS BELOW

Each advertiser listed in this index has been assigned a code letter for use by the reader in securing additional information about advertised products or services which interest him. This code letter appears in parentheses to the left of the advertiser's name.

●

Circle the code letter on the "Advertised Product Inquiry" card (on the page opposite) which corresponds to that assigned the advertiser about whose product you want further information.

Fill in your name, title, company and mailing address and mail the card . . . no postage is required.

The Petroleum Processing Reader Service Department will give your inquiries prompt and efficient handling.

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WHAT'S NEW . . .

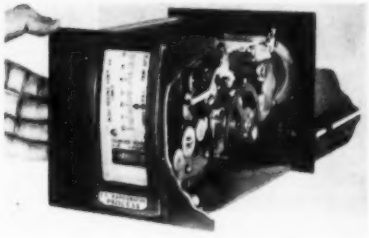
Explosion-proof Mixer for Labs Will Handle up to 50 Gallons

. . . of hazardous fluids. Approved by Underwriters' Laboratories for Class I, Group D, and Class II, Groups E, F, and G services, it is said to be the only electric laboratory mixer designed for these classes. It will handle low-viscosity fluids in quantities up to 50 gal. and lesser volumes of high-viscosity fluids. Mixer clamps on the rim of any vessel, or it may be clamped to a separate support. A universal ball joint with screw-type locking clamp permits adjustment to any desired angle. Mixer weighs 22 lbs. The 1/20 hp., totally-enclosed motor turns the shaft at a constant speed of 1750 rpm., and operates on 110-volt, 60-cycle, single phase A.C. Motor shaft is suspended on sealed ball bearings; with a third sealed ball bearing to support the tube holding the mixer shaft. For replacement or change of shafts, a chuck connects the shaft to the drive tube. Tube, chuck, shaft, and propellors of the Model XP are available in various metals and alloys. Mixing Equipment Co., Inc., 135 Mt. Read Blvd., Rochester 11, N. Y.

Circle No. **1** *on Reply Card*

For More Information

Use one of the attached reply cards to request additional details or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the rest of the card and drop it in the mail. No postage is required.



Miniature Integrator-Indicator Utilizes Full-size Mechanism

. . . and a standard 5-digit counter. It is one of the series of "Ratographic" miniature instruments designed primarily for use in graphic panels. The device, measuring 6 x 6 x 14⅝ in., indicates instantaneous rate and continuously integrates the measured variable. Flow rate of the measured fluid is sensed and totaled every 2.5 secs. This allows varying flows to be totalized to accuracies within 1% of full scale. Further, it makes the totalizer responsive enough to take full advantage of the sensitivity of flow rate meters. Totalizing mechanism is oil-immersed for permanent cleanliness, lubrication, and freedom from wear and corrosion. Indication is on a vertical strip by a pointer attached to the integrator calibration cam. Pneumatic receiver operates at signal pressures from 3 to 15 psig. A heavy duty 100 rpm. synchronous motor establishes the timing base for the integrator, its low speed eliminating delicate high-speed gear trains. The unit may be combined with an impulse-type counter to operate shut-off or other end point control devices after a certain flow has been measured. Fischer & Porter Co., 15 Jacksonville Rd., Hatboro, Penna.

Circle No. **2** *on Reply Card*

New Line of Lubricated Plug Valves Now Made Available

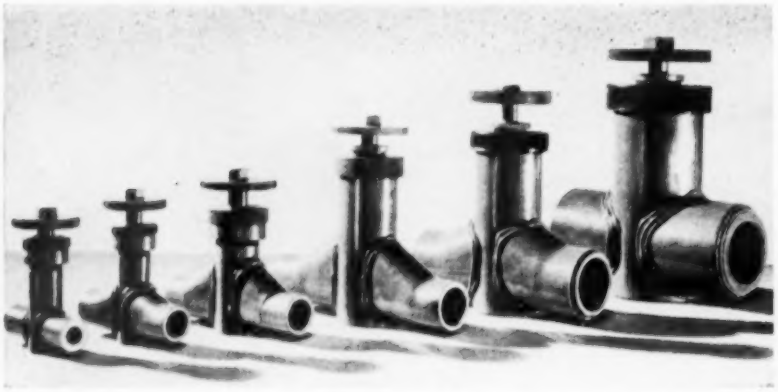
. . . by old line manufacturer. In semi-steel and steel construction, the Powell valves are all wrench-operated and require only a quarter turn to open or close. Lubricant grooves surround each port to provide a positive seal. In an open position, seating surfaces are not exposed. The valves are furnished with screwed or bolted glands. Semi-steel units are available for 175 and 200 lb. W.O.G.; carbon steel for 150 and 300 lbs. W.P. The Wm. Powell Co., 2525 Spring Grove Ave., Cincinnati 22, Ohio.

Circle No. **3** *on Reply Card*

Oxygen Recording Equipment Has Quick Initial Response

. . . of from 8 to 12 seconds, with 90% of final reading in 35 seconds. Calibrated accuracy of 0.15% oxygen against standard gas mixtures can be adjusted in the unit by means of recorder-dial rheostats to any plant standard. This accuracy, coupled with a sensitivity of better than 0.05% oxygen, is said to provide the user with reliable and responsive data for precise analysis of plant or process operation. Stability of better than 0.15% oxygen is inherent in the double-bridge, null-balance measurement. Effects of changes in ambient or sample temperature and pressure are canceled out. No tank samples are needed, since calibration is checked against air. Development of fully automatic gas clean equipment for the sampling system reduced maintenance requirements, it is stated, and the design has eliminated filters wherever possible. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

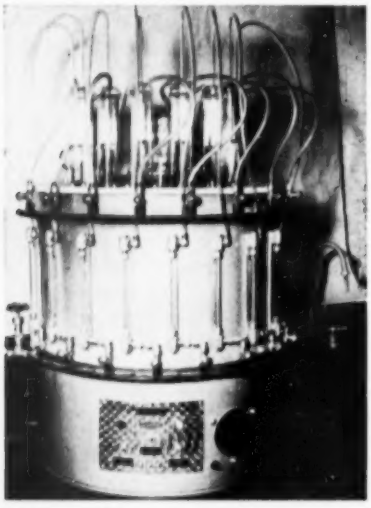
Circle No. **4** *on Reply Card*



Valves Added to Line of Plastic Pipe

Needle and globe valves made of an unplasticized polyvinyl-chloride have been made available for use with the "Boltaron" line of pipe and fittings, and are furnished in standard IPS sizes of ⅛, ¼, ⅜, ½, ¾, 1, 1½, 1¼ and 2 in. The material, Boltaron 6200, is said to have high chemical resistance to organic and inorganic acids, alkalies, and alcohols. Specific information is available from the manufacturer. H. N. Hartwell and Son, Inc., Boston, Mass.

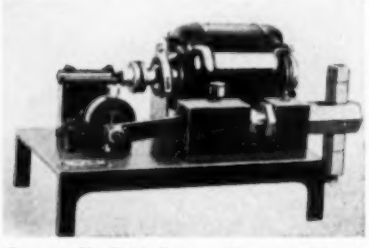
Circle No. **5** *on Reply Card*



New Oxidation Test Apparatus Designed for Many Oil Products

. . . including automotive and aircraft, steam turbine, and electric transformer oils. It will meet the specifications for apparatus of five accepted standard oxidation tests, it is said. These tests are: ASTM D-943, ASTM D-670, the von Fuchs test, the Koppers Co. Method C-50 A revised, the Indiana oxidation test, and the British Air Ministry modification of that test. It may also be used in any other test requiring contact between and oil at a constant temperature, and a metered volume of air or oxygen. Individual micro rotameters meter air or oxygen to each test cell. Temperature regulation is by electronic relay and thermoregulator. Complete unit has eight glass test cells, and necessary accessory equipment. Bath capacity is 18 gal. Thermoregulator is of bimetallic type with regulation to ±0.1° C. Operation is on 115 volts, 60 cycle: power requirement is 1200 watts. Technical Equipment Co., 743 Dwight Way, Berkeley 10, Calif.

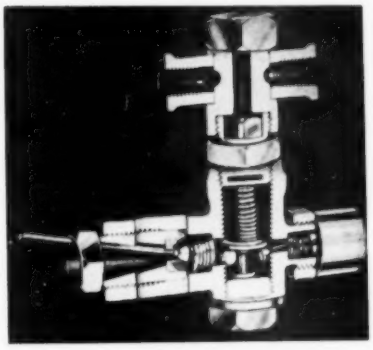
Circle No. **6** *on Reply Card*



Controlled Volume Pumps Have Ranges Down to 3 ml./hour

. . . or as high as 50 gpm. against pressures to 20,000 psi. The new "CC" Pumps will handle such materials as abrasive slurries, suspended solids, viscous, and corrosive chemicals, or light solvents, liquefied gases, and liquids at various temperatures. Construction is of several materials, including brass, nickel, 18-8 stainless steel, plastic, Hastelloy, C and B Monel, cast iron, or steel, as required by the user. Pumps are of the reciprocating, positive-displacement type, equipped with ¼, ½, or ¾ hp. motors with speed reducers and an adjustable stroke plunger. Steel check balls at the pump end seat positively so there is no loss of liquid with each stroke of the plunger. CC Pump Mfg. Div., Palmyra, N. J.

Circle No. **7** *on Reply Card*



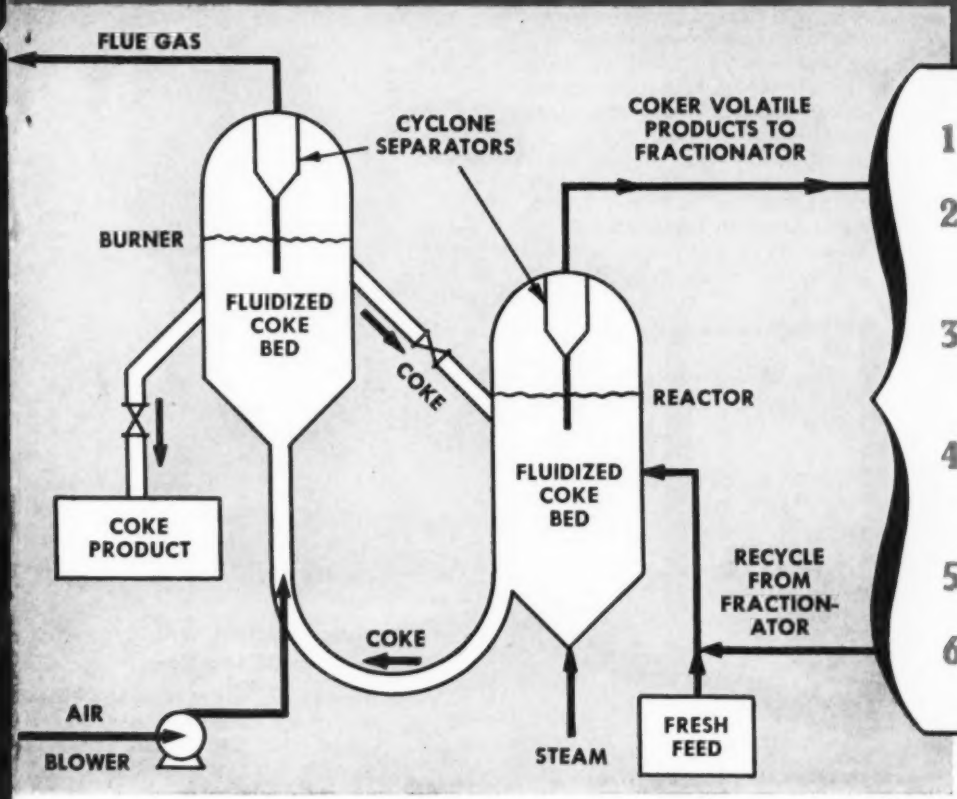
New Wobble-Rod Controlled Air Valve Widens Range of Uses

. . . of the unit in pneumatic circuitry. The lever which opens and closes the valve is a hardened rod, so swivelled that the free end can move vertically, laterally, diagonally, or in arcs and circles. Accordingly, the valve can be actuated (manually, mechanically, or electrically) by any type of motion. The internal exhaust valve will automatically discharge when the valve closes, but can be eliminated where desirable to hold air line pressures after the valve has done its job. Another integral feature is a check valve (ahead of the ball-and-seat) to prevent backsurge. Body casting is designed to permit two valves to be assembled into one unit. This can provide a common inlet, a common outlet, simple series connection, or total independence of the two valves. Bronze, brass, and stainless steel construction is used throughout. There are no rubber or fiber seats or diaphragms. Mating parts seal without gaskets or packing, and are threaded together without bolts or flanges. Dissimilar metals are used at all friction points to prevent galling and reduce operating forces. Springs are all of the compression type. Range of usefulness of the valve is up to 125 psig. Open valve diameter is ¼ in. Overall dimensions are 3⅛ in. by 5 in. by 4⅝ in. high. Pantex Mfg. Co., 521 Roosevelt Ave., Pawtucket, R. I.

Circle No. **8** *on Reply Card*

FLUID COKING*

offers you these advantages



1. **Continuous operation**
2. **Broad flexibility of both feed and products**
3. **Higher ultimate gasoline yield**
4. **Residual products yield reduced to a minimum**
5. **Low plant investment**
6. **Economical operation**

* *Licensed by Standard Oil Development Co.*

McKee Engineering Assures You Correct Plant Design

MCKEE services assure you a Fluid Coking plant designed and constructed to obtain fullest advantages of this new process.

MCKEE Company's enlarged process engineering facilities, design, engineering, purchasing and construction services are backed by a long, successful record on all types of refining facilities.

For Fluid Coking, as for all the other refining processes, you can depend on it—*McKee Engineering means Assured Results.*

ENGINEERING, PURCHASING AND CONSTRUCTION FOR THE PETROLEUM REFINING AND IRON AND STEEL INDUSTRIES

Arthur G. McKee & Company • Established 1905

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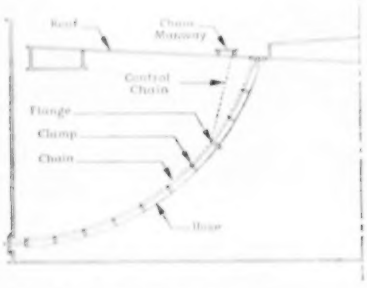
British representatives of Metals Division: Head, Wrightson & Company, Ltd.
Canada: Arthur G. McKee & Company of Canada, Ltd., 350 Bay St., Toronto 1, Ont.

New Vacuum Pump Has High Speed in Low Pressure Ranges

. . . and is designed specifically for use in large volume dehydration and vacuum metallurgical systems. Designated as the single-stage Oil Ejector Pump, Type KB-1500, can produce an ultimate pressure of 5 x 10^{-3} mm. of Hg. while operating against a limiting forepressure of 0.5 mm. of Hg., and has an air removal rate in excess of 3000 cfm. The pump can be used on systems containing large amounts of dust and other impurities because of its wide internal jet clearances. To facilitate installation, the inlet and outlet connections have standard 150-lb. pipe flanges of 12-in. IPS and 4-in. IPS respectively. The fully insulated boiler is equipped with an electric immersion type heater. Consolidated Vacuum Corp., Rochester 3, N. Y.

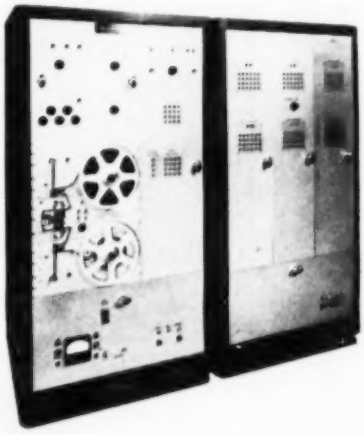
Circle No. **9** *on Reply Card*



Floating Roof Maintenance Eased by Replaceable Hose Drain

. . . without requiring tank cleaning. When it is necessary to change a hose, the sequence of operations is as follows: Lower the oil in the tank to about the one-foot level. The flanged joint, where the two sections of hose are joined, is drawn up to the deck by the supplementary control chain, through the chain manway provided for this purpose. Disconnect the two sections of hose and tie a length of rope from the deck through the chain manway to the end of each section. Then, by unbolting the flange connection at the deck and sheel, each section of hose can be withdrawn. Replace the support chain in the new hose. The two ropes, which had been attached to the ends of the hose sections where they were joined together, are attached at the same points on the replacement hose sections. The two new sections can be pulled into place by hauling up on these ropes. Secure the deck and sheel connections, flange the end sections of hose together, attach the control chain and disconnect the two ropes. The floating roof is then ready to go back into service. General American Transportation Co., Chicago, Ill.

Circle No. **10** *on Reply Card*



Magnetic Memory-Digitizer Speeds Up Handling of Data

. . . by eliminating the need for alternating measurement and sampling cycles. Designed originally for use in aircraft and missile testing, it is expected to find wide applications in industrial and business fields. The techniques established in the development of the reversing decades, shift registers, card punch translators, and other units have promise in these fields. An important element in the data reduction process is the digital magnetic-tape handler which is used as the basic recording medium. High speed and precise control of tape starts and stops permit recording of data from all four channels at high rates and playback at the slower speeds required to accumulate the information on tabulating cards, or for insertion into electronic computers. Individual components or complete systems are now available to provide sampling rates to 100/sec., and these may be combined with existing or proposed methods employing punched cards, direct data printers, or magnetic tape recorders. Potter Instrument Co., Inc., 115 Cutter Mill Rd., Great Neck, N. Y.

Circle No. **11** *on Reply Card*

New Lubrication System Will Reach as Many as 36 Locations

. . . with minute quantities of lubricant, regardless of the differences in pressures required. The "Lo-Flo" Lubricator is available in 18 or 36-feed models, with or without group regulation of feeds. Flow rate per feed ranges from 2.3 cu. in./hr. to less than 1 cu. in. per 700 hrs. A wide variety of lubricants can be used, ranging from light oils to light grease at 60° F. Outlets can be manifolded internally to increase flow to selected bearings, and the unit can be used with separate or integral reservoir. Lo-Flo is available with a number of drives, including rotary shaft, built-in ratchet, solenoid and pressure pulsation of liquids or gases, all provided in several gear ratios. For larger systems, a number of remoted-located lubricators can be driven and supplied from a convenient central station. The unit is self-lubricated and self-priming. With 500 psi. working pressure and 1000 psi. relief, there is sufficient pressure to overcome line blocks. Nathan Mfg. Corp., 416 East 106th St., New York 29, N. Y.

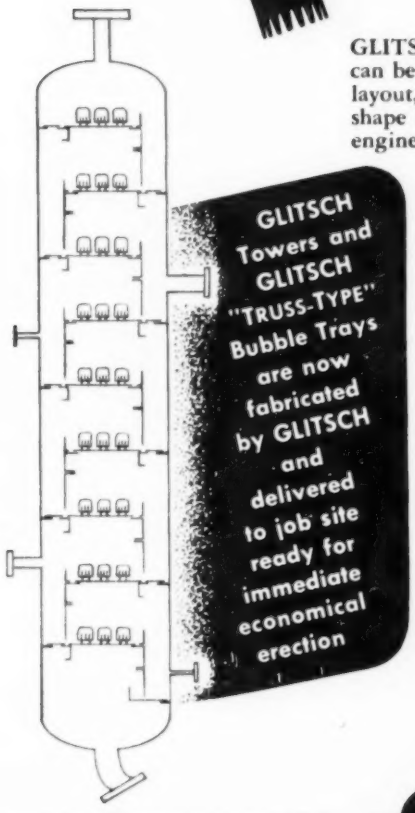
Circle No. **12** *on Reply Card*

DESIGN YOUR PROCESS REQUIREMENTS WITH COMPLETE FREEDOM OF LAYOUT

Glitsch CAN FABRICATE TO YOUR SPECIFICATIONS

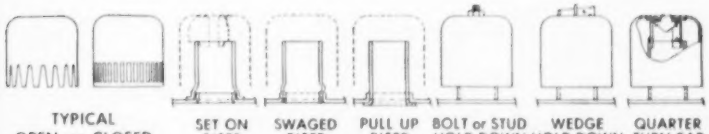
This is the *Glitsch* "TRUSS-TYPE" Mechanical Design

You specify your process requirements



GLITSCH Towers and GLITSCH "TRUSS-TYPE" Bubble Trays are now fabricated by GLITSCH and delivered to job site ready for immediate economical erection

GLITSCH "TRUSS-TYPE" lightweight trays, simple and adaptable in design, can be utilized for any process requirement with respect to tray size, process layout, type of flow, type and shape of downcomer, weirs, wells, and size and shape bubble caps as well as a suitable corrosion resistant material. Process engineers are not bound to standardized patterns. In collaboration with GLITSCH engineers, customers' management and engineering staffs can effect definite savings in initial designing while planning exact fabricated features desired.



...279 Cap and Riser Assembly Designs

Dies are available for 279 different cap and riser assemblies. Bubble cap styles can be furnished in a wide range of slots. Hold down styles simplify clean-outs, reduce "off-stream" time to a minimum.

Glitsch Service

World-wide service in initial planning, designing and fabrication of towers and internal equipment based on specific customer requirements, engineering surveys of existing facilities and cost analyses are promptly available.

Glitsch "TRUSS-TYPE" Bubble Trays, Towers and other Petroleum Refinery, Chemical and Industrial Equipment

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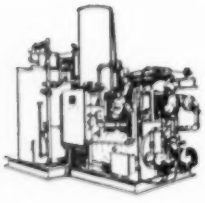
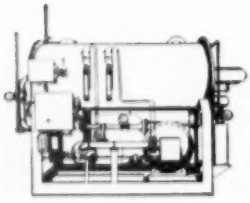
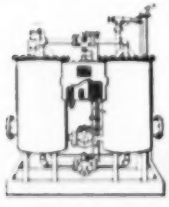
FRITZ W. GLITSCH & SONS, INC.
P. O. Box 6227
DALLAS 2, TEXAS

SALES OFFICES:
NEW YORK CHICAGO
CLEVELAND TULSA
HOUSTON LOS ANGELES

Controlled Atmospheres







Atmospheric control is not new. It was first achieved by wise old Mother Nature who saw in this ability untold possibilities.

The modern chemist, bottler, manufacturer, metallurgist, or food packer knows of the many advantages of controlling the atmosphere. He uses such control to prevent explosions or plugged paint lines, to get fizz into soft drinks and to make dry ice, to achieve perfect welding and heat treating of metals, to keep foods fresh, and in hundreds of other ways.

Modern gas generation equipment has made it possible for even the small user to generate his own special gas—nitrogen, carbon dioxide, annealing, inert, etc.—at tremendous savings. So, if your business requires atmospheric control or special gases you'd be wise to get the last word in this equipment. It's available simply by dropping a card to Gas Atmospheres, Inc., outlining your particular problem.

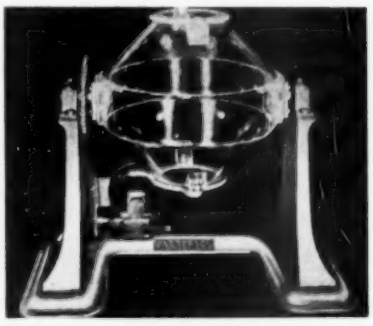
Gas Atmospheres, Inc., builds a complete line of controlled atmosphere equipment including Inert, Annealing, Reducing, Nitrogen and Carbon Dioxide Generators; Refrigerant and Dessicant Dryers, and Gas Purification equipment.

gas Atmospheres, inc

equipment for producing industrial gases

20011 WEST LAKE ROAD CLEVELAND 16, OHIO

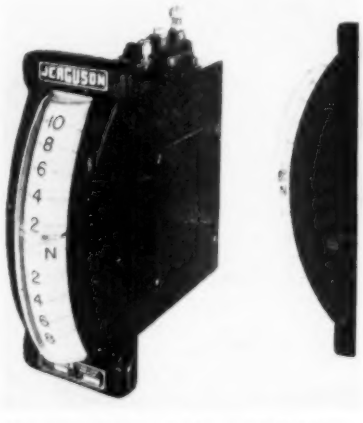
A LEE WILSON ENTERPRISE



Dry Mixer Permits Study of a Wide Range of Blend Problems

. . . in research and development, or control work in the laboratory. The new Type "L-P" Dry Blender provides means for investigating: effects of changes in blending times; effects of changes in consistency of raw materials; density differences; effects of particle size and shape; and many other typical mixing factors. With a diameter of 12 in., it has a gross capacity of 0.5 cu. ft. and a batch or working capacity of 0.31 cu. ft. It will handle materials weighing up to 100 lbs./cu. ft. Patterson Foundry & Machine Co., East Liverpool, Ohio.

Circle No. **13** *on Reply Card*



Convex Scale Raises Visibility Range of Liquid Level Gage

. . . to full 180° permitting reading of liquid level from anywhere in the control room from which the gage cover can be seen. Markings are directly on the convex face and indicator goes clear around the convex surface of the new model of the "Truscale." Accuracy is 0.5% of scale reading. Compensated manometric gage meets new interpretation of the boiler code for WSP of 900 psi. or higher. There are no stuffing boxes. Models are available for any pressure

Which of these metals will

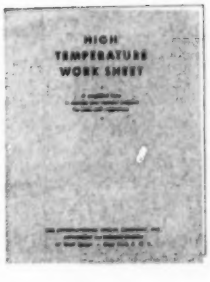
solve your High-Temperature problem?

Even the INCO Nickel Alloys may not provide a pat answer to that question, for strange reactions can take place when metals are exposed to high temperature corrosion.

When INCO's High Temperature Engineers do not have a known solution to your particular problem in all their amassed research information, they work with you to find it by testing the comparative durability of metals and alloys under your actual operating conditions.

First step is to write for this work sheet so that you can turn your problem over to INCO's High Temperature Engineering Service.

INCO



THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

Please send me the High Temperature Work Sheet so that I may outline my problem to you. PP-10-53

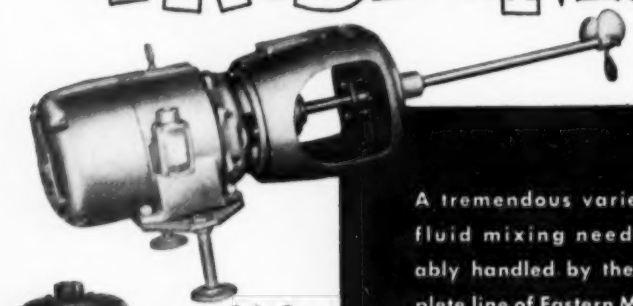
Name _____

Address _____

City _____ State _____

(To obtain more data on advertised products see page 1584)

SOLVE YOUR MIXING PROBLEMS

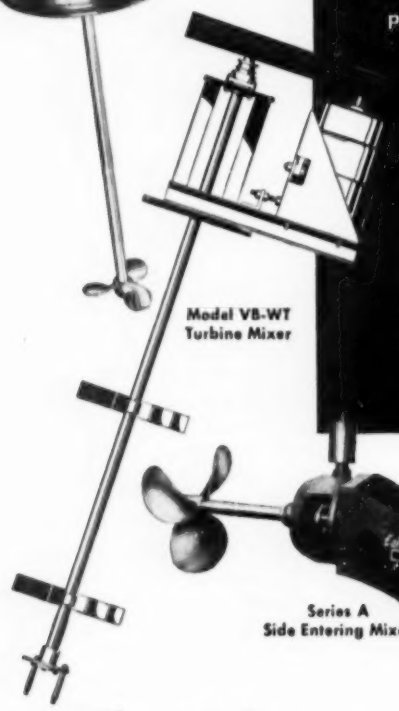


Series C
Side Entering Mixer

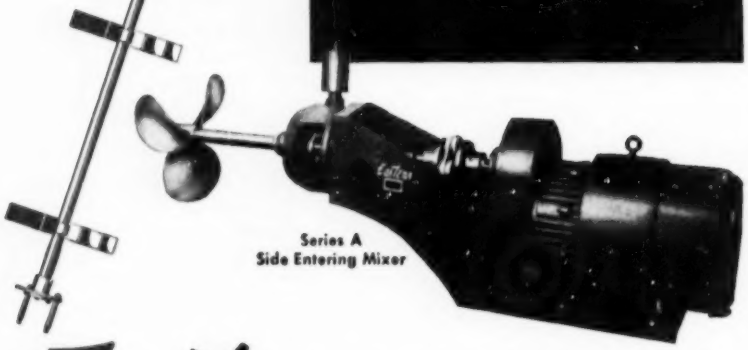
Series C
Top Entering Mixer

A tremendous variety of fluid mixing needs are ably handled by the complete line of Eastern Mixers. Size and power of mixers are flexible to help solve your problems. For complete information and engineering data, write for Eastern Fluid Mixing Catalogs. Eastern engineers are always available to work out your complex mixing problems with you.

EASTERN INDUSTRIES ★ MIXER DIVISION ★



Model VB-WT
Turbine Mixer



Series A
Side Entering Mixer

Eastern INDUSTRIES, INC.
Dept. F, Regent St., Norwalk, Conn.

and range. Light and horn alarm signals, as well as Truscale Repeaters for repeating gage reading at auxiliary points, are available. Jerguson Gage & Valve Co., 80 Fellsway, Somerville 45, Mass.

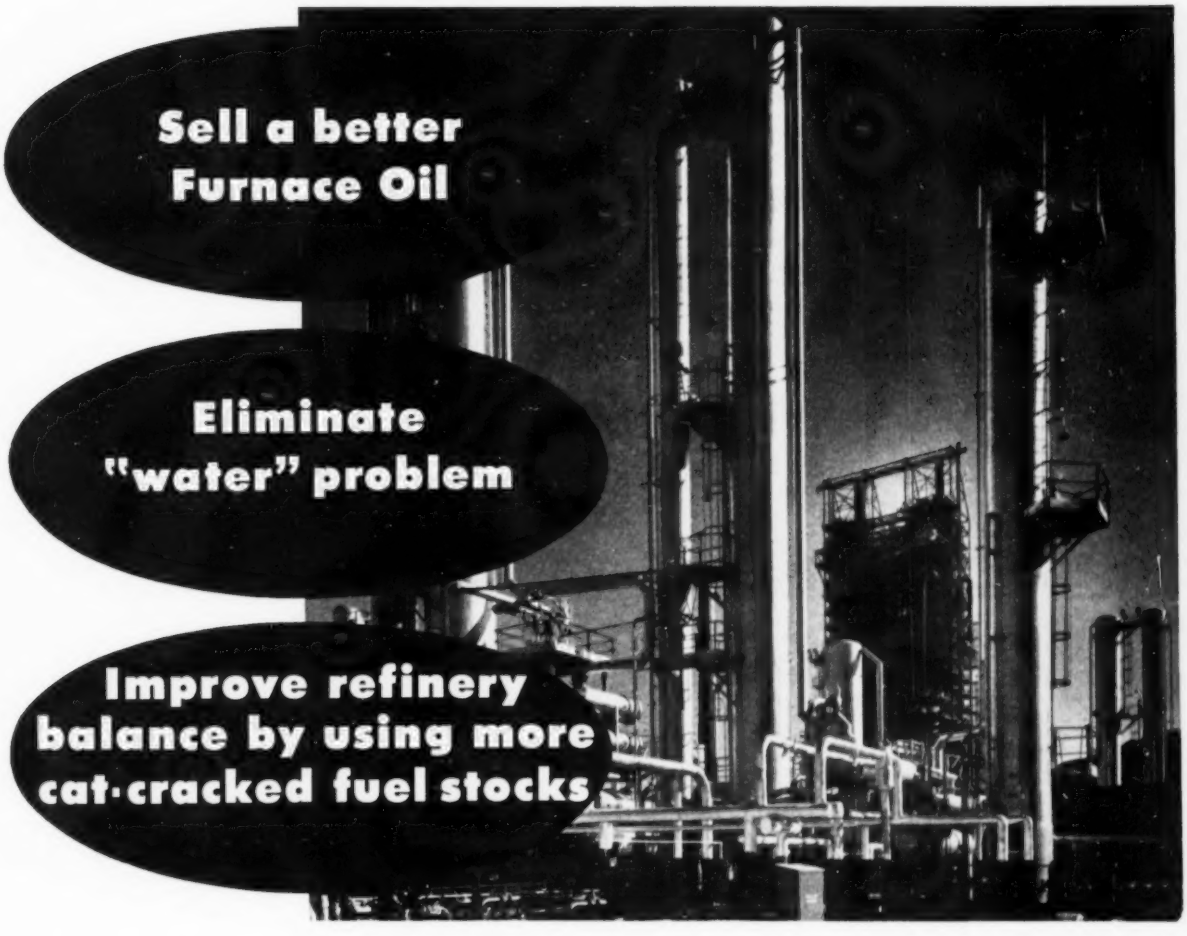
Circle No. **14** *on Reply Card*

Special Insert Permits Joint of Plastic Tubing & Metal Fittings

. . . to be made in a matter of seconds. Illustration shows a "semi-exploded" view of the three elements involved in a connection, with the new "Swagelok Insert" in the middle. The insert is placed in the end of the tubing, a finger-tight Swagelok Tube Fitting is placed over the end and the nut tightened with an ordinary wrench. The new inserts, available in any metal, protect the tube fittings against cold flow in the plastic and support the inside dimension of the plastic tubing while the torque-free fitting grips and seals the outside dimension. Resistance to chemical action and oxidation, non-contaminability, visibility, and extreme flexibility of Tygon plastic tubing—when used in conjunction with the Swagelok inserts and fittings—make the combination helpful and useful in laboratory service. Ordinarily, the more rigid plastic tubings do not require an insert. Crawford Fitting Co., 884 East 140th St., Cleveland 10, Ohio.

Circle No. **15** *on Reply Card*

With NEW Dispersant FO



Dispersant FO is a new anti-gumming, rust-inhibiting additive that greatly reduces, even eliminates, deposits and screen clogging in home heating units and storage tanks. Your product with FO will offer dealers many competitive advantages and greatly reduce their number of costly service calls due to clogged filter screens and nozzles.

"Water" is always *the big problem* for the distributor, dealer and home user. The active ingredient in FO is an entirely new chemical, developed especially for use in furnace oils. NEW DISPERSANT FO DOES NOT EMULSIFY WATER WITH BURNER OIL. It will settle the water out of burner oils in short order to provide a "dry" fuel.

Furnace oil with FO has exceptional rust-proofing properties. Steel and iron surfaces in contact with the oil are made corrosion resistant.

This new additive improves stability and permits the blending of higher percentages of cat-cracked stocks without additional gum formation. It improves refinery balance, and you can cut costs by reducing the severity of acid treating of your cat-cracked heating stocks.

The stabilizing action and rust-inhibiting quality of Dispersant FO are obtained at very low dosages. Usually added in the ratio of 1 pint per 1000 gallons of oil stock, at any temperature, prior to shipment by tanker, pipe line or truck.

For complete product data and samples, write or phone the nearest Oronite office.

ORONITE CHEMICAL COMPANY

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30 ROCKEFELLER PLAZA, NEW YORK 20, NEW YORK
STANDARD OIL BLDG., LOS ANGELES 15, CALIFORNIA
600 S. MICHIGAN AVENUE, CHICAGO 5, ILLINOIS
MERCANTILE SECURITIES BUILDING, DALLAS 1, TEXAS

ORONITE CHEMICAL COMPANY
THE NAME TO WATCH IN CHEMICALS

(To obtain more data on advertised products see page 1584)

Now "Varec" offers a new Remote Reading ELECTRONIC TANK GAUGE RECEIVER . . .

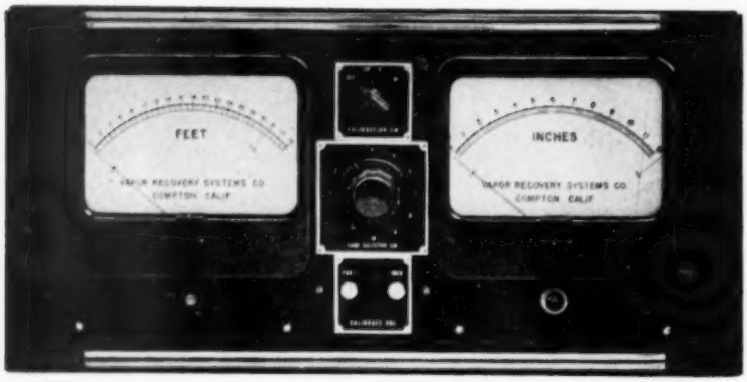

FIGURE NO. 8800 SERIES

. . . for 36-foot Range Tanks and Smaller

SPECIAL DESIGN—This new "Varec" RECEIVER has the many advantages of our larger range RECEIVERS, but is especially designed for tanks not exceeding 36 feet in height.

INCREASED EFFICIENCY—Reduces operation costs and increases plant efficiency. Provides accuracy, unusual speed, sensitivity.

EASY READING—Allows larger increments on foot-reading scale, permitting easy reading.

FLEXIBLE INSTALLATION—Designed in Standard, Relay or "On Gauge" types in cabinet or panel styles and can be used with electronic alarms or controls.

CHOICE OF CALIBRATION—English, Metric or special calibration as desired.

REASONABLE UNIT COST—With all its attractive features, this Figure Number 8800 SERIES RECEIVER has a very reasonable first cost.

Get all the details and illustrations in Bulletin CP-3004, just off the press.

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COMPTON, CALIFORNIA, U.S.A.
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THE VAPOR RECOVERY SYSTEMS COMPANY
2820 N. Alameda Street, P. O. Box 231
Compton, California, U.S.A.

Company Name_____
Name_____ Title_____
St. and No._____
City and State_____ 88-1

Continuous Ink Supply Is a Feature of New Meter Pen

. . . designed for use on American Meter Co. or other makes of recording instruments. It is said to permit operation for periods up to a year with only one filling and virtually no attention. Pulsating flow, rapid pen movement, and atmospheric fluctuations are claimed to have no effect on ink flow, and the chances for errors through unrecorded intervals are eliminated. Pens are stainless steel, and non-clogging. Ink flows by capillary fed upward through a flexible plastic tube connected to a half-ounce reservoir. This reservoir, suspended inside the instrument case, protects the ink from dust and atmospheric contamination. The "Cannon" Meter Pen can be mounted on installed instruments and are available in various types for all standard recorders. Complete kits for field installation are available, or new recorders can be equipped with the Cannon Pens. American Meter Co.

Circle No. **16** *on Reply Card*

Optical Unit Permits Inspection Of Hard-To-Reach Locations

. . . with five-power magnification. The "Inspecto-Scope" comprises two main parts; an eye-piece housing the optical system set at 45° from the end-tube; and the end tube, equipped with a midget bulb, bulb protector, mirror, switch, battery cable, and poles. The object or surface to be inspected visually is illuminated, and the image reflected back to the eye-piece. The end-tube revolves 360°, which allows inspection of all inside surfaces or sides of an object without changing

no. 2 of a series

GUIDES TO GASHOLDER PLANNING

"'Sore thumb' gas works hurt community relations . . .

How about a good-looking gasholder?"

Residents of an eastern city were aroused when word spread that a sewage digester gasholder was being planned in their neighborhood. They visualized a "sore thumb" superstructure with rigging looming high overhead, thought of property values skidding because they'd have an ugly, old-fashioned gas works as a new neighbor. Their protests posed a serious problem in community relations for the company.

The installation of a handsome, compact Wiggins Gasholder solved the problem to everybody's satisfaction. The only truly *modern* gasholder, the Wiggins gasholder is not only safe, efficient and economical but—due to its simplicity—it's also *good-looking*. *Dry* fabric seal and self-aligning piston eliminate unsightly exterior mechanisms required for other types of gasholders. For complete facts, write General American.

Wiggins Gasholder

WIGGINS VAPOR-SEALS GENERAL AMERICAN

GENERAL AMERICAN TRANSPORTATION CORPORATION

135 South La Salle Street • Chicago 90, Illinois • **Offices in Principal Cities**

It's MORE than fire safety, SIR . . .

. . . . it's ENGINEERED "Automatic" fire protection

When it comes to the planning of fire protection for your plant or business, there's considerably more to be viewed than the price. Of course, you will want to be fully informed on the economics of protecting your property, but it's equally important to know that the method of protection is the best available for any given area of your building.

It is for that reason that through the years we have not limited ourselves to the design and installation of only certain types of protection. Like you, we study the economic factors involved. Then, following a thorough investigation of all elements of your overall fire safety problem, we design, manufacture and install the type of protection *best by test* for maximum safety. It's *engineered* "Automatic" FIRE PROTECTION for you . . . the finest available at any price!

Why not find out how *engineered* "Automatic" FIRE PROTECTION can save dollars for your business whether you ever have a fire or not. Remember, what's worth insuring is worth protecting.

Write for Bulletin 66, the ABC of Fire Protection. It's FREE.

"Automatic" Sprinkler
CORPORATION OF AMERICA
YOUNGSTOWN, OHIO
Offices in principal cities of North and South America

position of the eye-piece. Construction is all-metal except for a plastic eye-cap: exposed metal parts are nickel-plated. Overall length of the device is 17 in.: end-tube only is 12 in. Bulb is powered by standard 1.5 volt dry battery. Overall weight, including a hardwood carrying and storage case is 5¼ lbs.: instrument only weighs 1¼ lbs. Badger Sales Co., Inc., 2251 West Pico Blvd., Los Angeles 6, Calif.

Circle No. **17** *on Reply Card*

Device Extends Ultracentrifuge Analysis Range Downward

. . . in the macromolecular region from molecular weights of about 10,000 to about 500. "Spinco Synthetic-Boundary Ultracentrifuge Cell" is designed to permit measuring the sedimentation constant of a slow component in the presence of a fast component. Principle of operation depends on layering of one solution, the supernatant over the mixture under study, thus producing a boundary away from the meniscus. Or, in the case of two components, layering a solution containing only the fast component over a mixture of the fast and slow mediums. This procedure artificially creates a boundary of the slow component in the presence of the fast one, and measurements of the movement of this boundary are made by conventional optical methods. Cell resembles a standard analytical ultracentrifuge unit having quartz windows supported by sectoral end pieces, secured by screw-ring into a cylindrical housing. In the wall of the housing, however, is cut a circular hole which, when the cell is assembled, is aligned with an opening in the sectoral center piece of the cell in place of the small filling hole normally located at this point. A ⅜-in. diameter stainless-steel cup with 1/64-in. diameter hole in its base near the periphery, is supported in

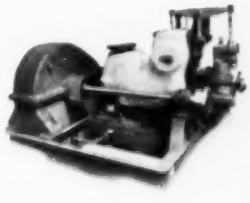
This diffuser-type valve gives Type M Turbine extra steam efficiency

This Westinghouse engineered diffuser is the key to achieving highest possible steam efficiency and accurate steam control in multi-valve turbines. The unique, long-diffuser design produces the lower pressure-drop effect of oversized valves. It does this by actually accomplishing a steam pressure recovery after the steam passes the valve seat. This pressure recovery means higher efficiency—*more production* per pound of steam.

Smoother steam flow is attained by the specially contoured valve head. Using steam vortex action, it centers precisely regardless of load, temperature or pressure variations. Result—*minimum wear* of valves and guides—long-term reliability and low maintenance.

These unusual design refinements which make such an efficient governing valve system possible can only come from a 50-year record of experience on turbines from 1 hp to the largest made. They are typical of the many Westinghouse improvements which have been combined with time-proved principles to bring industry its most flexible and modern line of general-purpose turbines. Get the full Westinghouse story *first* —to be sure your new or replacement steam drive has *all* the possible advantages for your particular operation. Call your local Westinghouse office or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-50559

TYPE M GENERAL-PURPOSE TURBINE



One of the many Type M applications, coupled to a reduction gear for industrial drive. It is a multi-stage, multi-valve type with ratings from 1000 to 10,000 hp and 1000 to 7500 rpm. Most advanced of all general-purpose turbines, it can be combined with a complete line of accessory equipment for every operating requirement.

Turbines for every industrial use

YOU CAN BE **SURE**...IF IT'S

Westinghouse

CORROSION
IS COSTING YOU
TIME AND MONEY

YOU CAN SAVE BOTH WITH
UNICOR

THIS NEW UOP CORROSION INHIBITOR—
WHICH IS SPECIALLY FORMULATED
FOR THE PETROLEUM REFINER

PREVENTS

COSTLY METAL LOSS AND
EXCESSIVE MAINTENANCE DUE TO
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IN CONDENSERS, TANKS,
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Let UOP engineers design and service a UNICOR system for your protection.

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PRODUCTS DEPARTMENT

UNIVERSAL OIL PRODUCTS COMPANY

30 ALGONQUIN ROAD DES PLAINES, ILL., U.S.A.

this opening by the shoulders on either side of the sectoral opening. In use, the bottom solution is placed in the sectoral cell. The cup is then put in place with the pinhole resting against a rubber valve, which seals the cup, and filled with the solution to be layered on top. A rubber gasket fits under the cover and seals the assembly. During acceleration of the rotor, the rubber valve is opened under influence of the centrifugal field and the liquid in the cup drains slowly through the pinhole until it has all been layered over the solution in the sectoral part of the cell. In this way the boundary is created synthetically and at a reproducible speed in the rotating cell. This technique is said to permit formation of sharp boundaries in the presence of appreciable diffusion, which in a conventional cell would prevent boundary formation. Specialized Instruments Corp., 623 O'Neill Ave., Belmont, Calif.

Circle No. **18** *on Reply Card*

Vacuum Gage Monitors Five Positions in a Single System

. . . using a switching unit and a single gage. Plants or laboratories can establish permanent multiple point monitoring for measurements in the low micron range. Practical for widely separated indications because the calibration is not affected by length of cable from indicator to gage tubes, the instrument makes possible continuous readings without affecting system pressure. Range of the gage is 1-1000 microns Hg. It has noble metal thermocouples and nickel plated gage tubes affording freedom from outgassing, system contamination, and corrosion. Calibration of gage tubes is not affected by exposure to atmospheric pressure or change in ambient temperature. Matched gage tubes eliminate the need for adjustments when switching. Hastings Instrument Co., Inc., Hampton, Va.

Circle No. **19** *on Reply Card*

a valve that never blows its top

All K & M diaphragm Control Valves have a drawn steel diaphragm casing able to withstand extreme heat, impact, pressure and shock . . . and a cast steel open yoke that retains its strength when the heat is on. When something goes wrong, the difference between safety and danger might very well be this all steel construction.

Further, consider the everyday advantages of the all steel K & M construction: One man can move the smaller size valves without hoists, for the K & M steel topworks weighs only half as much as other topworks of equal size. The open yoke, provided in cast steel by *only* K & M, assures accessibility and completely eliminates any possible accumulation of gas, vapor or condensate.

More linear . . . more accurate . . . more responsive

The K & M molded neoprene diaphragm provides a large effective area which is constant throughout the long stem travel. Thus, K & M Diaphragm Motors provide maximum linearity in stem movement and virtually the highest power factor available. Operating with high capacity, low turbulence K & M valve bodies, these motors mean more accurate, more responsive flow regulation.

For Complete Automatic Control Valve Data: Write for your copy of the new K & M Valve Engineering Data Catalog, Bulletin CV53. *Also Available . . . New Valve Size Calculator with Low Flow Data.*

diaphragm control valves

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J-M BLAZECRETE speeds refractory repairs...

That's why it pays you to use this hydraulic setting refractory for temperatures to 3000F

REPAIR old refractory linings—or build new ones—quickly and economically with Blazecrete*. For troweling, just mix Blazecrete with water as you'd mix ordinary concrete . . . then slap-trowel it in place.

When gunned, it adheres readily with a minimum of rebound loss. Either way, Blazecrete goes on fast . . . without laborious ramming or tamping. *And Blazecrete linings last.*

Three types of hydraulic-setting Blazecrete are available. All harden on air curing, do not require prefiring. They are furnished as a dry mix . . . can be stored safely for use as needed.

3X BLAZECRETE—For temperatures through 3000F. Unusually effective for heavy patching, especially where brickwork is spalled or deeply eroded. Excellent for forge furnace linings, lime kilns, burner blocks, soaking pits, and industrial boilers.

STANDARD BLAZECRETE—For temperatures through 2400F. Makes repair work easier and less costly. Can be used by boiler manufacturers to replace fire clay tile in wall construction. Suitable for use in combination with 3X Blazecrete and L. W. Blazecrete.

L. W. BLAZECRETE—For temperatures through 2000F. An insulating refractory . . . light in weight, low in thermal conductivity. Adaptable and economical for many other applications.

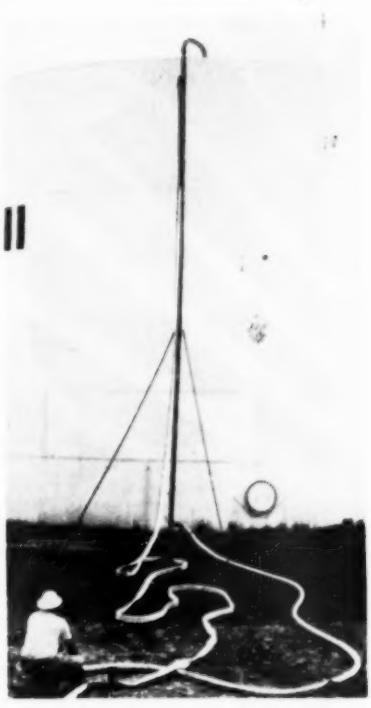
Send for Brochure RC-28A on Blazecrete and its companion material, Firecrete*. . . the hydraulic setting castable refractory for making special shapes and linings. Write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay St., Toronto 1, Ontario.

*Reg. U. S. Pat. Off.

Whether you gun it... *or slap-trowel it...*

Johns-Manville **BLAZECRETE**

BUILDS BETTER REFRACTORY LININGS



Portable Foam Tower Can Be Raised by Hydraulic Action

. . . to full height in a matter of seconds. "National" hydraulic foam tower can be handled with less men. Hydraulic action, which can be applied at a safe distance from the fire, elevates the unit to a point above the upper edge of the tank wall. Pressure is then released at the controlling locatian and the tower descends until the gooseneck is hooked over the edge. Foam is discharged against the inside tank wall, flowing down across the burning surface. Compact construction of the unit not only allows easy handling and storage, but also permits tower erection in congested areas. Once set up, a scissors-type frame prevents the tower from moving, except toward the tank itself. Units may be used with either the manufacturer's Aer-O-Foam or chemical foam systems. National Foam System, Inc., West Chester, Penna.

Circle No. **20** *on Reply Card*

Five-Bolt Line Blind Valve Is Built for Larger Pipe Lines

. . . in the 18-in. size. It has an ASA rating of 150 lb. for working pressures up to 230 lb. Neck of the spectacle plate is suspended on the top bolt so it can be revolved in either direction when opening or blinding the line. The two side bolts swing out,

Cancer strikes one in five

Strike back

By saving lives, by easing pain, by improving services to cancer patients, by supporting research that will find the final answers to cancer . . .

That is how your dollars strike back at cancer when you give them to the American Cancer Society.

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Give to conquer cancer

American Cancer Society

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Burrell modern reagents and auxiliary solutions are recommended as standard, to be used with all types of gas analysis equipment. Solutions are fresh, uniform and of superior quality.

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DISORBENT ◎ for Carbon Dioxide. Crystal clear potassium hydroxide solution. Accurate and fast.
CAT. NO. 39-730—16 oz. 2.75.....Case of 12—27.00
CAT. NO. 39-731—3 oz. 1.30.....Case of 12—14.40

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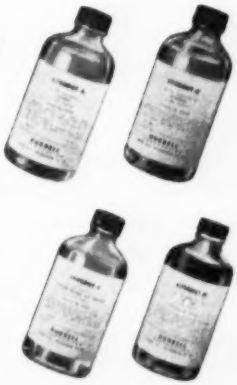
Note: Approx. 8 oz. equals a charge in a standard absorption pipette; 3 oz. for Industro® gas analyzers.

SPECIFICS FOR HYDROCARBONS



SORBENT "A" ◎—For total olefins, ethene, propene butene and pentenes.
CAT. NO. 39-741—8 oz. 4.00.....Case of 12—42.00

SORBENT "B" ◎—For selective absorption of iso-butene. Takes up 1-butene and 2-butene slowly.
CAT. NO. 39-742—8 oz. 2.25.....Case of 12—24.00

SORBENT "C" ◎—For propenes, butenes and pentenes. Will absorb ethene slowly.
CAT. NO. 39-743—8 oz. 2.25.....Case of 12—24.00

SORBENT "D" ◎—For acetylenes and higher members of the acetylene series.
CAT. NO. 39-744—8 oz. 5.00.....Case of 12—54.00

Prices listed are F.O.B. Pittsburgh, Pa.

For additional listings ask for Bulletin No. 327

BURRELL CORPORATION
Manufacturers and Distributors of
SCIENTIFIC APPARATUS and LABORATORY CHEMICALS
2223 Fifth Avenue, Pittsburgh 19, Pennsylvania

WHY INSULATE YOUR CONDENSER TUBES?

You may be doing just that if your plans don't include CHLORINATION EQUIPMENT for slime control by WALLACE & TIERNAN.

Chlorination equipment because it controls slime that *grows* on the walls of condenser tubes not protected against it. Enough of the growth eventually seriously reduces heat transfer efficiency — actually *insulates* your steam from the cooling water. Back pressures go up, production drops, operating and maintenance costs rise, and eventual shut-down becomes necessary for regular clean-out periods.

Wallace & Tiernan equipment because it is versatile, sturdy and dependable — proven by thousands of successful installations, vouched for by satisfied users everywhere—and because there's a Wallace & Tiernan chlorinator for every job. Write today for information on how Wallace & Tiernan chlorination may help you solve *your* slime problem.

NO WATER IS SLIME-FREE

regardless of the source. Chlorination helps reduce slime in process or cooling water.

CD-37

WALLACE & TIERNAN COMPANY, INC.

CHLORINATION CHEMICAL CONTROL EQUIPMENT

NEWARK 1, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES

thereby making it unnecessary to remove any bolts when reversing the spectacle plate. Easily operated by one man, the five bolts on this 18-in. model are quickly spread and tightened, even in close-coupled, compact manifolds. The bar-operated bolts eliminate wedges, hammers, and wrenches needed for spreading conventional flanges, and they eliminate the fire hazard of sparking. Constructed regularly of carbon steel, the new valves can be made of other materials for special requirements. Standard packings are Hycar, a synthetic rubber, which will perform satisfactorily in most services where the temperature is not too high. Other packing materials can be obtained for specific requirements. Hamer Oil Tool Co., Long Beach 6, Calif.

Circle No. **21** *on Reply Card*

Trade Literature

"Automatic" Factories

. . . considered as a coming reality by the president of an instrumentation company; excerpts from a recent talk by Henry F. Deever on how close we are to completely automatic manufacturing, and what it's going to mean to the American economy; in 16-page pamphlet. Minneapolis - Honeywell Regulator Co., Minneapolis 8, Minn.

Circle No. **22** *on Reply Card*

Pipe Line Repair Clamps

. . . both single and double types; specifications and prices listed in tabloid-size pamphlet. Morris Coupling and Clamp Co., Dept. M-38, Ellwood City, Pa.

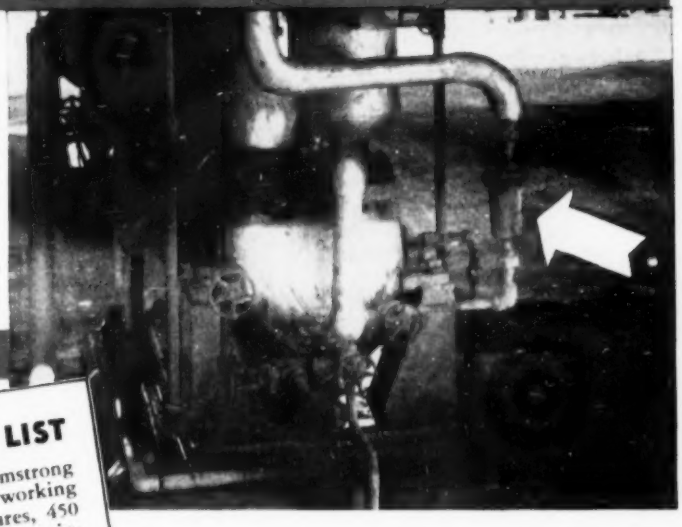
Circle No. **23** *on Reply Card*

ARMSTRONG *Forged Steel* TRAPS FOR ALL PRESSURES

1. High Shock Resistance.

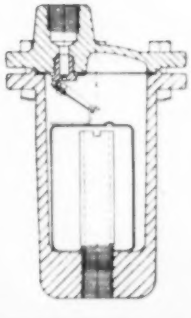
2. Bodies Will Withstand Fire.

3. The Cost Is Low.



No. 3211 — ONLY $20.00 LIST

Right—Here's the baby of the Armstrong forged steel line, a low priced trap for working pressures up to 250 psi—design pressures, 450 psi. Capacity range 750 to 1000 lbs/hr continuous. Diameter 4¼", height 7", weight 8 lbs. Available with ½" or ¾" connections. Standard Armstrong interior mechanism. Here's forged steel safety for only a few dollars more than a cast iron trap! Available for shipment from stock. Write today.



Cross-section of an Armstrong No. 3211 forged steel trap. Forged cap and body. Compressed graphited asbestos gasket. All stainless mechanism. This trap will take high temperatures and abuse without danger of fracture.

MORE and more refineries and natural Gasoline plants are using ARMSTRONG FORGED STEEL TRAPS, even at pressures as low as a few pounds. The extra safety in case of fire or an explosion more than justifies the moderate additional cost.

To use cast iron or semi-steel traps puts a weak link in the chain of steel pipe, steel fittings and steel valves. The shock of a distant explosion could fracture the cast iron traps.

Why take a chance when Armstrong forged steel traps cost so little more than cast iron?

A "standard" in high pressure power plants throughout the world, Armstrong forged steel traps are the perfect answer for extra safety and dependability in the petroleum industry. Prices are modest. For complete data, send for your copy of the ARMSTRONG STEAM TRAP BOOK.

ARMSTRONG MACHINE WORKS

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See Armstrong at the Oil Show—Booth 32, Texas Bldg.

ARMSTRONG *Inverted Bucket* STEAM TRAPS

Factory Representatives in 48 Key Cities... Traps Stocked at 147 Points

For Eye-Level Readings...

AUTO-LITE

TEMPERATURE INDICATORS

- Precision-built indicators provide accurate temperature readings.
- Low-cost protection . . . due to large, specialized production.
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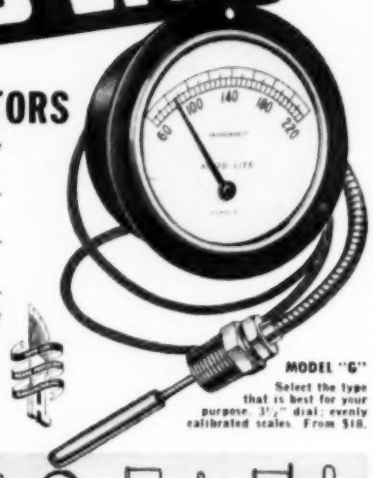
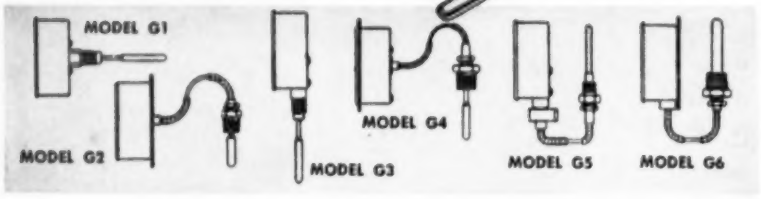


MODEL "G"
Select the type that is best for your purpose. 3½" dial; evenly calibrated scales. From $18.

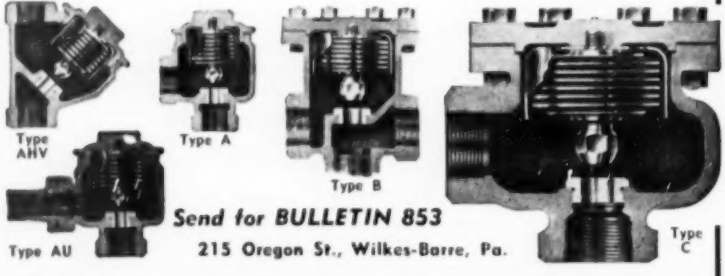


NICHOLSON TRAPS

SAVE CAR OF COAL WEEKLY

for This Large Steam User

Following replacement of all steam traps of various makes, with Nicholson units, an Eastern college reports: — "An average coal saving of 1 carload per week besides much better heat distribution". Credit is given the higher and more even temperatures which Nicholson traps effect. See why large industrial and institutional steam users are increasingly standardizing on Nicholsons. 5 types; for heat, power, process; sizes ¼" to 2"; press. to 250 lbs.



Send for BULLETIN 853
215 Oregon St., Wilkes-Barre, Pa.

W. H. NICHOLSON & CO.
TRAPS · VALVES · FLOATS

What's New!

Power Generation

. . . and distribution in the petroleum and chemical industries; 12-page *Technical Article GER-764* originally appeared in the March and April, 1953, issues of *Chemical Engineering* and was written by W. B. Wilson of the G-E Industrial Power Division. General Electric, Schenectady 5, N. Y.

Circle No. **24** *on Reply Card*

Tubular Equipment Data

. . . card, which tabulates maximum allowable stress values of a complete range of seamless and welded carbon, alloy and stainless steel tubing and pipe; at elevated temperatures and pressures; in *Data Card TDC* 154. Babcock & Wilcox Co., Beaver Falls, Pa.

Circle No. **25** *on Reply Card*

Gas Analysis Equipment

. . . for many kinds of laboratory and field testing; 48-page *Catalog* 81 illustrates and prices each item, and gives recommendations on proper selection; prices on such accessories as reagents, manifolds, etc., are also included. Burrell Corp., 2223 Fifth Ave., Pittsburgh 19, Pa.

Circle No. **26** *on Reply Card*

Entrainment Separators

. . . and mist eliminators for improving performance of vacuum towers, distillation equipment, etc.; 4-page *Bulletin* 15 sets forth the advantages of the manufacturer's equipment, tells how it should be used. Otto H. York Co., 69 Glenwood Place, East Orange, N. J.

Circle No. **27** *on Reply Card*

Expansion Joints

. . . and metal hose used in petroleum processing and handling; 8-page *Bulletin CMH-136* gives dimensions, weight, etc. and illustrates structural features. Flexonics Corp., 1392 S. 3rd Ave., Maywood, Ill.

Circle No. **28** *on Reply Card*

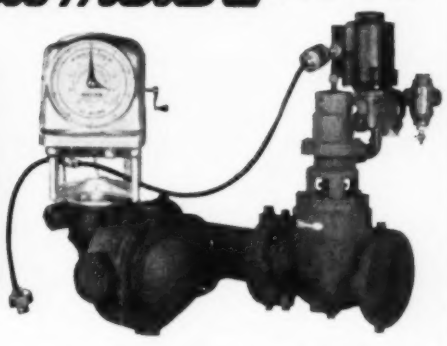
Cemented Tungsten Carbide

. . . for balls and seats in subsurface pumps used in the petroleum industry; *Bulletin B-100* includes data on the abrasion, corrosion and impact resistance of carbide in addition to information on its composition and manufacture. Carboloy Department, General Electric Co., Detroit, Mich.

Circle No. **29** *on Reply Card*

THE *Fluidometer* SYSTEM

for the automatic batching of light or heavy liquids



Adaptable to a wide variety of measuring problems

The Fluidometer System provides an accurate, dependable, and completely automatic method for batching liquids, either light or heavy. It is available in either jacketed or unjacketed construction, and is adaptable to practically any liquid measuring problem, whether it involves gallons, barrels or tank car lots. Equally accurate on liquids of high or low viscosity. Anything that can be handled through a meter can be accurately batched by the Fluidometer. The automatic reset, an exclusive feature of Fluidometer, is invaluable in large scale production work requiring steady repetition of operations.

Bulletin FI-49, giving complete information on the Fluidometer System, will be sent on request.

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SERVING INDUSTRY FOR 41 YEARS

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- Combination Gas and Oil Burners
- Tandem Block Combustion Units
- Fuel Oil Pump Sets
- Refractory Burner and Muffle Blocks
- Valves, Strainers, Furnace Windows

Detailed Information gladly sent you upon request.

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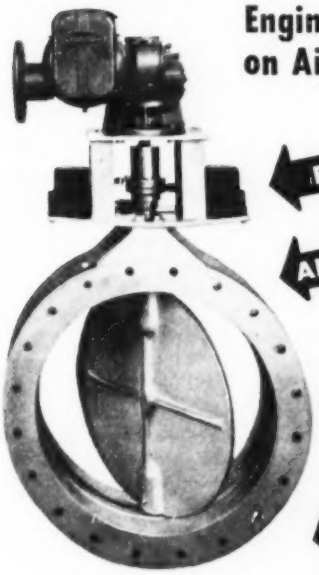
W. S. ROCKWELL VALVES

Engineered for Dependable Service on Air, Gases, Liquids, Semi-Solids



FULL FLOW with minimum pressure drop.

ANY CONDITIONS of commercial, drip- or bubble-tight closure, with quick, positive control and shut-off manually or automatically.

RESISTANT Made ruggedly for all conditions of corrosion, erosion, temperatures to 2000° F., pressures to 300 p.s.i.

ALL TYPES Butterfly, wafer or slide valves, 1" to 120" pipe size.

ROCKWELL SINCE 1888 BUILT

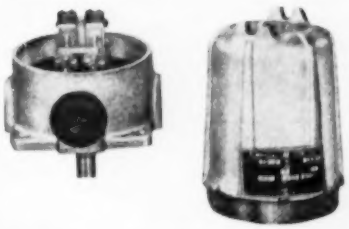
W. S. ROCKWELL COMPANY

BUTTERFLY VALVES • SLIDE VALVES • AUTOMATIC VALVES

2533 ELIOT STREET • FAIRFIELD, CONN.

Sales Representatives in Principal Cities

Explosion Proof Temperature Limit Switch



The Burling Model VD-2X above is an explosion proof, two switch temperature control. Each switch operates an independent circuit and may be set for different temperatures.

Other Burling Features

- Ranges from — 300°F to + 1800°F
- Electric or Pneumatic
- One, two, or three Micro Switches
- Differential Expansion of Solids No liquids — no gases
- For controls, safety alarms, cut-outs.

Send for Catalog G-18

Burling Instrument Company
4 Vose Avenue
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Burling Temperature Controls

It's a Matter of Record

It's a Matter of Record

REFINING . . . NATURAL GASOLINE AND PETROLCHEMICAL PLANTS OPERATE ON A 24-HOUR . . . SEVEN-DAY-A-WEEK BASIS. WHEN YOU NEED A PUMP FOR YOUR PLANT YOU DON'T RUSH OUT WITH A WAD OF BILLS AND BUY A PUMP . . .

It's a Matter of Record

YOU SPECIFY Precision Built Pumps by PACIFIC PUMPS INC. because pumps for your exacting service are a considered purchase and

It's a Matter of Record

that customers say . . . "We believe Pacific is just about the finest group of pumps we know anything about."

It's a Matter of Record

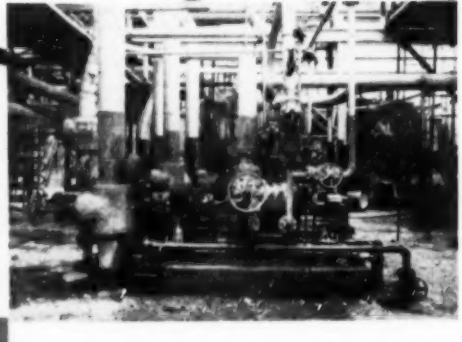
That in the continuous process industries . . . shutdowns are costly . . . maintenance is a big problem . . . availability of parts and service facilities are important.

It's a Matter of Record

That customers say . . . "Pacific Pumps Inc. is large enough to stand behind the product they manufacture and small enough to give each order individual attention."

It's a Matter of Record

The excellent performance of the two stream-turbine driven four-stage pumps installed in 1939 to pump light hydrocarbons of .465 sp. gr. operating at 3400 R.P.M. In 1942 the speed was increased to 3900 R.P.M. From 1939 to 1950—time on stream 82 + % . . . pump parts refinished 0 . . . pump parts replaced 0. Third unit installed in 1947 to operate at 4000-4200 R.P.M.



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Pacific Pumps inc.

ONE OF THE DRESSER INDUSTRIES

HUNTINGTON PARK, CALIFORNIA

Export Office: Chanin Bldg., 122 E. 42nd St., New York

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CP-8

What's New!

Refinery Process Burners

. . . of the manufacturer's Type MU combination gas-oil, and Type S vertically or horizontally fired premix gas; construction features and schematic drawings in 4-page *Bulletin* 703-*A*. Peabody Engineering Corp., 580 Fifth Ave., New York 36, N. Y.

Circle No. **30** *on Reply Card*

Chemicals Chart

. . . of materials derived from oils and fats; 17 x 27-in. sheet shows composition and specifications on seven adol fatty alcohols, ten hydrofol glycerides, 14 hydrofol fatty acids and nine sperm oil products. Archer-Daniels-Midland Co., 2191 W. 110th St., Cleveland 2, Ohio.

Circle No. **31** *on Reply Card*

Power Systems

. . . of hydraulic and pneumatic types, showing 15 applications of the company's service; 4-page *Bulletin* 753-5*M* pictures units, tells how they are being used in many phases of industry. The Rucker Co., 4228 Hollis St., Oakland 8, Calif.

Circle No. **32** *on Reply Card*

Portable Potentiometer

. . . with direct reading temperature and extended range scales; 4-page *Bulletin* 1210 covers wiring diagrams, installation instructions, specifications and special features. Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves, Philadelphia 44, Pa.

Circle No. **33** *on Reply Card*

Technical Services

. . . of an engineering firm; 22-page brochure explains what the company can do for customers, and who else will do it if they can't. Foster D. Snell, Inc., 29 W. 15th St., New York 11, N. Y.

Circle No. **34** *on Reply Card*

Lubricated Plug Valves

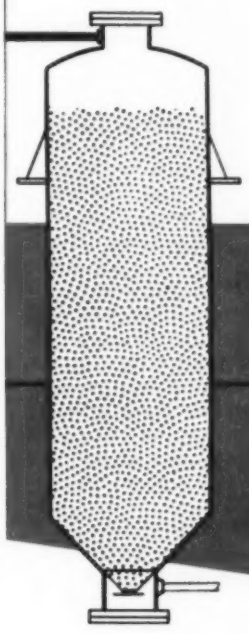
. . . steel and semi-steel in many types; dimensions, weights, prices and illustrative material in 12-page *Catalog PV-2* (Revised). William Powell Co., Cincinnati 22, Ohio.

Circle No. **35** *on Reply Card*

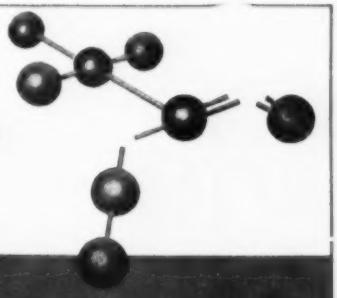
Electronic Level Indicator

. . . for continuous indication at local or remote stations; described and illustrated in 8-page bulletin. Robertshaw-Fulton Controls Co., 2920 N. 4th St., Philadelphia 33, Pa.

Circle No. **36** *on Reply Card*



...ready to tackle any sorptive-mineral job that comes along...



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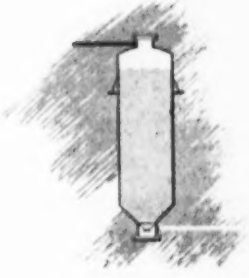
POROCEL Activated Bauxites

ADSORBENTS

There's an Attapulgus or Porocel adsorbent to fit your process technique for removing odors, colors, tastes, moisture, acids, sulfur, fluorides and unsaturates from process liquids or gases. Materials treated in principal applications are: motor oils and other lubricating, specialty, and technical oils; petrolatums and waxes; aviation and motor gasoline stocks; kerosene; diesel and heating oils; chemicals and petrochemicals.



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Our sorptive minerals are recognized standards in desulfurization, reforming and isomerization systems—catalytic removal of unsaturates—conversion of sulfides to elemental sulfur—fluid catalyst applications—as catalyst carrier in copper sweetening processes.

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We offer a wide range of reliable, thoroughly proved desiccants for drying air, hydrogen, carbon dioxide, hydrocarbon liquids and gases.

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ESTABLISHED 1915

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See almost 500 exhibits conveniently located on one floor, representing all phases of the chemical industries. Chemical engineers, chemists and skilled technical men will be on hand to offer the latest information and practical solutions to your processing production problems. See and compare, methods, materials, equipment, processes and techniques that will affect future trends in the chemical processing industries.

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✓ IS IT LUBRICATED THRUOUT - AND WEARS LIKE A BEARING ?	Yes
✓ WILL IT OPERATE WITHOUT SCORING SHAFTS, SLEEVES OR STEMS ?	Yes
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Prove this to yourself on your own equipment. Write for information on special types and styles of Durametallic Packings for your sealing needs. Ask for Bulletin No. DMPP. Durametallic Corporation, Kalamazoo, Michigan.

What's New!

Repair of Heat Exchangers

. . . calandrias and condensers; 4-page *Bulletin* 805 explains the company's repair services on processing equipment. Manning & Lewis Engineering Co., 28-42 Ogden St., Newark 4, N. J.

Circle No. **37** *on Reply Card*

Steam Turbines

. . . for centrifugal compressors and blower drives; 18-page *Bulletin* 1966-536-*BP* shows engineering features, including four types of governing arrangements, hand and automatic nozzle controls and other accessories. Worthington Corp., Harrison, N. J.

Circle No. **38** *on Reply Card*

Radioisotopes as Reagents

. . . in the laboratory; 11-page *Bulletin FS*-231 discusses the use of carbon-14 tagged compounds which require no AEC authorization for use. Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

Circle No. **39** *on Reply Card*

Recording Potentiometer

. . . with all parts interchangeable; profusely illustrated bulletin shows structural details of these simplified models, specifications, chart ranges, ordering procedure, etc. Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.

Circle No. **40** *on Reply Card*

Gate Valves

. . . in both all-iron and iron body, bronze mounted styles; engineering details are shown in cut-away drawings in 4-page *Circular* 561, which also contains dimensions and pressure ratings. Lunkenheimer Co., Box 360, Cincinnati 14, Ohio.

Circle No. **41** *on Reply Card*

Strain Gages

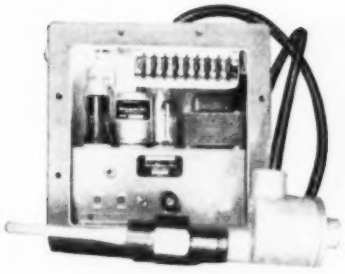
. . . instruments and accessories; specifications for 105 sizes and types of gages are tabulated; cement and waterproofing equipment also included; in 12-page bulletin. Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa.

Circle No. **42** *on Reply Card*

Protective Coatings

. . . in three heavy duty types for rust-proofing and insulation; choice of coating and application techniques discussed in 6-page bulletin. Nox-Rust Chemical Corp., 333 N. Michigan Ave., Chicago 1, Ill.

Circle No. **43** *on Reply Card*



ELECTR-O-PROBE

Distinguishes liquid level, foam, or even interface between liquids

Probe of this "On—Off" instrument will operate at temperatures as high as 1500° F

USES: Controller gives an "on—off" signal when level covers the probe. Can be used to detect liquid or foam level and operates well with viscous fluids, acids, bead and powder catalysts or even in locating a liquid—liquid interface.

FEATURES: Sensitivity control may be adjusted so that instrument reacts to or ignores foam.

DESCRIPTION: Liquid level controller reacts to a change in capacity when probe is covered by a liquid or other flowable material. Capacitance change causes a radio-frequency oscillator to reduce or completely stop oscillation when level rises above the probe. Oscillation starts again when level falls below the probe. This change in operation is used to generate a DC voltage signal, which through an amplifier, operates the relay. A plug-in type relay is normally furnished with a DPDT set of contacts—other arrangements may be obtained for special applications.

For detailed information on any problem write to ELECTRONICS DIVISION of

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EXCEL-SO WATER SEPARATORS

for refinery applications

Provides continuous coalescing of water in sulphuric acid alkylation, caustic treating, polymerization, and other entrainment problems.

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HYDRAULIC JET CLEANER

LEAST EXPENSIVE TO BUY & OPERATE

MOST EFFECTIVE FOR HEAVY DUTY CLEAN-UP

Operated by ordinary plant steam and cold water lines, this unit propels a solid jet of extremely high pressured hot water and detergent. The discharge force completely cleans areas up to 30 ft. from operation point, reaching inaccessible machinery parts. Eliminates down time and scaffolding. Removes all soil, sludge, and encrusted deposits.

CUTS CLEANING COSTS UP TO 94%

FOR ANY PLANT WITH 5 PSI STEAM & UPWARD

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In petroleum processing plants XACTO meters have proved the most effective way to measure liquids . . . accurately and dependably. XACTO safely handles 662 different liquids in processing, blending, packaging and many other operations . . . in batching or continuous operation.

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REGIONAL OFFICES: Atlanta • Cleveland • Dallas • Fort Wayne • Kansas City • New York • San Francisco • Washington, D. C. • Canadian Plant and Sales, Hamilton, Ont.

(To obtain more data on advertised products see page 1584)

Automatic pH Control

. . . in water and industrial waste treatment; *Technical Bulletin* 55 outlines several typical systems in boiler feed water treatment; diagrams of actual installations illustrate the report. Milton Roy Co., 1300 E. Mermaid Lane, Philadelphia 18, Pa.

Circle No. **44** *on Reply Card*

Heat Transfer Insert

. . . said to make cooling water flow faster; principles of operation explained and illustrated with photos and schematic drawings in 4-page bulletin. F. R. Gross Co., 592 Crestview Ave., Akron 20, Ohio.

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Steam Traps

. . . how to install them, testing and preventive maintenance, inspection and repair; 8-page *Bulletin* 239 also contains 10 diagrams showing recommended trap hook-ups. Armstrong Machine Works, Three Rivers, Mich.

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Liquid Level Gages

. . . of the transparent type; a description of the manufacturer's line, together with detailed specifications, drawings, etc. on the five different models offered; in 4-page bulletin. Jerguson Gage & Valve Co., 80 Fellsway, Somerville 45, Mass.

Circle No. **47** *on Reply Card*

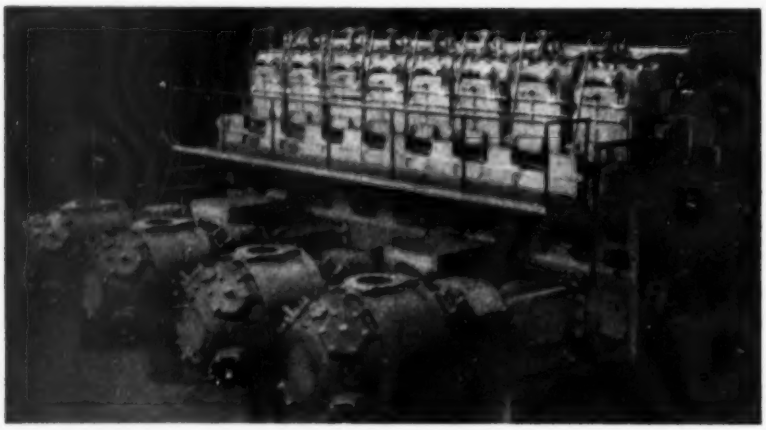
Pneumatic Controller

. . . of the motion balance type; 4-page *Catalog* 53-11 shows a working sketch and includes diagrams of three-line and four-line field-mounted systems. Fischer & Porter Co., 841 Jacksonville Rd., Hatboro, Pa.

Circle No. **48** *on Reply Card*

Temperature Indicator

. . . for thermocouples, electronic in operation; 4-page *Folder ND* 46-33*A*(2) contains pictures illustrating design features, as well as complete specifications, ranges and dimensions for the three available types of indi-



How one refinery eliminated scale build-up in compressors

Oakite Airefiner No. 52 prevents scale formation— cuts downtime, maintenance

Every 6 to 8 weeks a Southwestern refinery had to run acid through compressor water jackets to remove thick lime scale deposits. That meant compressors down for half a day. What could Oakite do?

The Oakite Man first descaled the jackets with Oakite Compound No. 32. Then he charged the spray pond with Oakite Airefiner No. 52, and set up a schedule for maintaining proper pH in the solution.

Results: Manifold temperatures reduced — no more descaling, no more cracked blocks or heads, no more compressor downtime.

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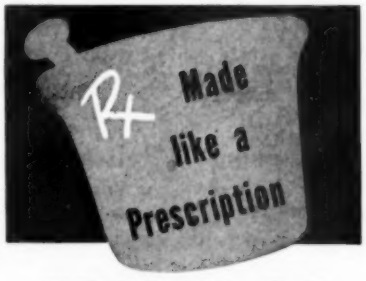

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cator. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

Circle No. **49** *on Reply Card*

Hi-Speed Steam Turbine

. . . for centrifugal compressor and blower drives; *Bulletin* 1966-536-*BP* gives manufacturing and engineering features, including four types of governing arrangements, hand and automatic nozzle controls and other accessories. Worthington Corp., Harrison, N. J.

Circle No. **50** *on Reply Card*

Scales, Balances

. . . for a wide variety of industrial and analytical uses; prices, illustrations and descriptive material contained in *Bulletin* 15C. Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.

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and here's why: It absorbs water instantly from gases and liquids in either a static or flowing system, is insoluble and will not swell or disintegrate in water. FLORITE gives a low dew point depression, and agressively resists "poisoning effects" which permanently destroy adsorption qualities.

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Did You Miss These?

The following, reviewed originally in August, have aroused considerable interest among the readers. They are repeated briefly as a service to those who might have missed them the first time they appeared in these pages. For details, or literature, please use the regular Reply Card in this issue.

New Lube Oil Treating Process Is Automatic

. . . replacing conventional batch agitation. The "Petreco Electric Lube Oil Treating Process" is designed for simple, continuous acid-treating of lube oils and similar stocks. Feedstock and treating acid are pumped into the mixing section and the acid-oil mixture continues on into the electric treater. From there, oil goes to the neutralization step, while sludge is drawn off got disposal or re-use. In commercial use, the manufacturer's treaters have a volumetric capacity of 90 bbl/hr. and are processing 2500 to 4000 b/d, depending on the type of oil treated. System is entirely enclosed, eliminating possibility of air pollution from escaping corrosive or noxious vapors. Oil sludge contact in the process is only about an hour, and in some cases, even less. Sludge is withdrawn continuously and automatically, eliminating entrainment of lube stock. Conversely, the electric field cuts the amount of sludge in the lube stock, obviating the necessity for a "water-gathering" operation on lighter lube oils. Petrolite Corp., 1390 E. Burnett St., Long Beach 6, Calif.

Circle No. **52** *on Reply Card*

New Pump "Squeezes" Fluids With Series of Steel Fingers

. . . simulating the action of the human hand. Fluid passes through flexible tubing held within the grips of this chrome-plated "hand" in the "Sigmamotor" Pump. Designed primarily to eliminate corrosion and/or contamination problems the device permits no contact between the fluid being pumped and the working parts. Pump mechanism proper has a hinged top so tubing can be simply placed in position without disconnecting either end. Sigmamotor will pump liquids, gases, or solids in solutions. It will handle from 45 to 250 gph., at an operating speed of 500 rpm. Different

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Designed for fuel oil and other viscous liquids, the Askania Transometer accurately measures flow and transmits a corresponding pneumatic signal.

This signal can be in the range of inches w.c., to match equivalent gas flow measurement; or in the standard instrument transmitter range of 3-15 p.s.i.

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Write for Bulletin 125

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Write for Bulletin 1152-P

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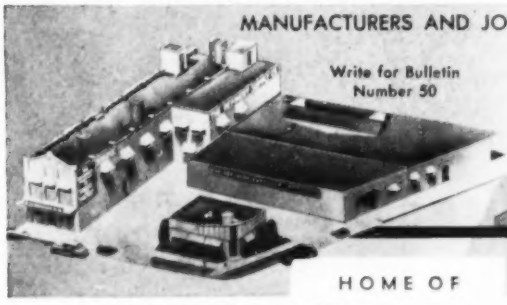

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The vise that's a handy portable workbench

RIDGID

New No. 40 Tristand Pipe Vise

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Work-Saver Pipe Tools

tubing sizes can be used simultaneously. Several fluids may be pumped in proportion, simultaneously and independently. Tubing recommended for use in the pump can be supplied by the manufacturer. The aluminum case is 12 in. high and has a 5-in. pulley on one side. Sigmamotor, Inc., 504 North Main St., Middleport, N. Y.

Circle No. **53** *on Reply Card*

Insulation Heat Loss Estimate

. . . sheet, used in preparing analyses of thermal insulation for heated industrial equipment; step-by-step instruction for recording survey data for each type of heated surface, with Btu and dollar savings provided by different types of insulation; in 4-page pamphlet. Industrial Mineral Fiber Institute, 441 Lexington Ave., New York, N. Y.

Circle No. **54** *on Reply Card*

Aldehyde Products

. . . booklet, describing the 14 aldehydes now being marketed by the manufacturer, including physical properties, specifications, test methods, uses, and suggested applications; in 36-page *Booklet F-5278*. Carbide and Carbon Chemicals Co., 30 East 42nd St., New York 17, N. Y.

Circle No. **55** *on Reply Card*

Aluminum in Process

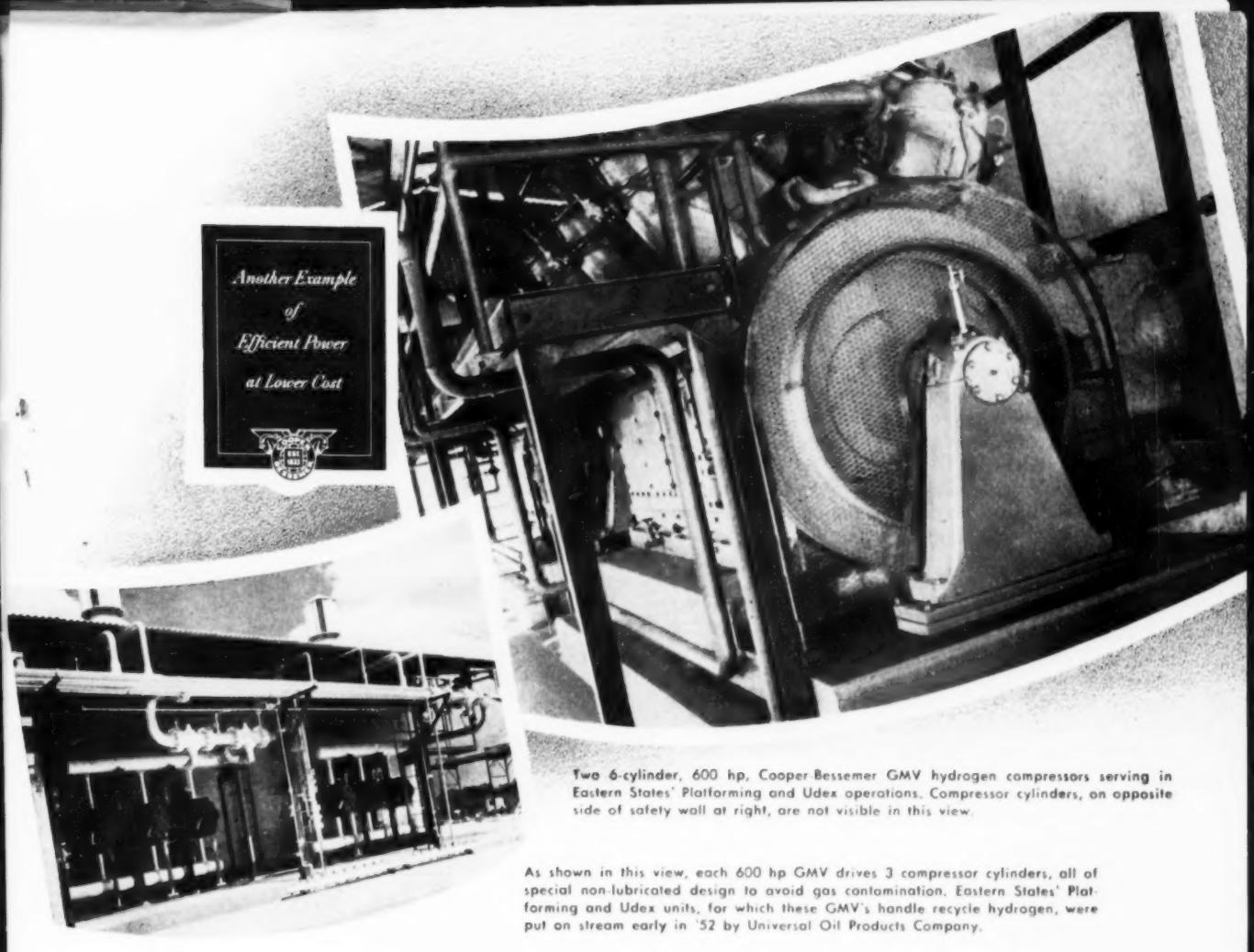
. . . industries; 8-page brochure lists economic advantages of this metal, composition and properties of alloys, tables covering materials safely handled by aluminum, and other engineering data. Aluminum Co. of America, 808 Alcoa Bldg., Pittsburgh 19, Penna.

Circle No. **56** *on Reply Card*

For Your Convenience

Business reply cards are included in each issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing the first page of this section. Just circle the numbers corresponding to the numbers at the end of each item. Then fill in the rest of the card and drop it in the mail. No postage is required.

(*To obtain more data on advertised products see page* 1584)



Two 6-cylinder, 600 hp, Cooper-Bessemer GMV hydrogen compressors serving in Eastern States' Platforming and Udex operations. Compressor cylinders, on opposite side of safety wall at right, are not visible in this view.

As shown in this view, each 600 hp GMV drives 3 compressor cylinders, all of special non-lubricated design to avoid gas contamination. Eastern States' Platforming and Udex units, for which these GMV's handle recycle hydrogen, were put on stream early in '52 by Universal Oil Products Company.

THEY LICKED A TOUGH PROBLEM

in Eastern States' Platforming Unit with Cooper-Bessemer GMV's

THE two GMV's shown here operate as recycle hydrogen compressors for the remarkable new Platforming and Udex units in the Houston refinery of Eastern States Petroleum Company, Inc.

In this processing it was particularly important to avoid contamination of the recycle gas. To solve this problem, Cooper-Bessemer successfully developed ***non-lubricated compressor cylinders*** with light carbon pistons and segmented carbon rings. Moreover, cylinder bores were honed to a mirror finish of 4 to 6 micro inches. Now, after thousands of hours of operation, checks show no excessive wear anywhere.

If you have a similar problem, or compressor requirements of virtually *any* type, you'll find Cooper-Bessemer ready to cooperate . . . as usual . . . all the way.

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EDITORIALS . . .

Let's Keep It in the Family

THE surplus refining capacity which the oil companies have built up in recent years at the behest of Petroleum Administration for Defense, as a part of our national defense program, has been a source of concern to the industry for some time. To its existence is attributed the present high volume of stocks of principal products and the continuing high rate of crude runs to stills.

This excess crude charging capacity now amounts to around 1,000,000 b/d. It was financed by the oil companies and represents an investment by these companies of some billions of dollars. The only compensation the companies have had is an allowance for accelerated depreciation for purposes of tax relief in the immediate years. The problem is recognized of finding some way for the oil companies to carry the load of this additional investment in surplus capacity, of providing the large funds for interest, depreciation and maintenance charges which will be required to maintain these facilities which are over and above those required to supply the industry's markets.

In discussions on this problem in Cleveland, last spring, at the meeting of the National Petroleum Association, Blackwell Smith, a New York attorney, pointed out that our anti-trust laws forbid cooperation within an industry to minimize and control the dangers of excess capacity, and stated his belief that some revision of the Sherman Act was needed to provide for such form of cooperation when it was in the public's best interest.

With the appointment of Mr. Smith, by Attorney General Brownell, to his panel to study our anti-trust laws in relation to their application to today's competitive conditions in industry, Mr. Smith's earlier remarks have been reviewed in some quarters. Donald C. O'Hara, counsel for the National Petroleum Assn., has suggested that the Brownell panel recommend some revision in the law for the preservation of the independent refiners, whom he sees being pushed out of business by the extreme competition among the large companies resulting from the surplus of refining capacity.

Any form of cooperation recognized by the government would call for supervision and regulation of the refining industry by a government agency. This, we believe, neither the large companies nor small refiners actually desire. Through all the relationship of the oil industry and government, going back to World War I, nothing has been developed in the form of artificial regulation that took the place of competition based on a sound price structure, and it is not likely that the panacea will be found through some form of legally authorized agreement among the oil companies.

The nation's refiners have operated before with surplus still capacity of 15% as at present, or even larger. The difference is that previous excess capacity was the choice of the companies, while this current overage was built at the government's insistence. While product stocks are large in volume, they are not so great when considered in the light of present consumption of motor fuel and heating oils. There are no economic conditions today which sound planning by the individual oil companies cannot overcome, and they should look to themselves for relief rather than considering handing the reins over to the government.

—V.B.G.

Fantastic Proposal for Smog Relief

THE latest resolution of Pasadena (Calif.) city directors asking that Los Angeles Basin authorities require refiners in that area to return to pre-war methods of refining gasoline as a remedy for their smog problem calls for immediate, hard-hitting rebuttal by the oil industry.

No one questions that Los Angeles has a serious smog problem. Scrapping modern refining methods of producing gasoline has not been demonstrated as a means for mitigating this atmospheric condition, however, and the proposal will turn back the clock on technological developments that have so greatly improved the quality of the public's motor fuel. The ignorance of Pasadena's manager and city fathers is clearly limelighted by the resolution's implication that today's automobiles can operate successfully on pre-war motor fuel.

The oil and allied companies in this area should now take off the gloves and hit back, by telling just what this ill-advised Pasadena resolution would mean to the public.

They should explain what 1940 gasoline would do in a 1953 automobile, how mileage and performance would suffer, what mechanical modifications in cars would be required—and then ask if the public wants to foot the bill.

The oil companies should also show that the petroleum refiners are by no means the principal offenders in producing smog conditions; that household incinerators and automotive exhausts alone put much more smog-producing elements into the Basin's peculiar atmospheric conditions than do the refiners, even without the mitigation devices which the plants have been required to install. They should ask that the automobile exhausts and householders' incinerators be required to put on anti-smog devices and tell the public what these would cost.

—D. P. T.

Curtis W. McGraw

It will remain a deep regret to the staff of PETROLEUM PROCESSING that its members had so short a time to work under the inspiring leadership of Curtis W. McGraw, president and chairman of the board of the McGraw-Hill Publishing Co., who died September 10.

We were privileged to gain some insight into his broad philosophy of business journal publishing, which was to lead in the task of keeping business well-informed, shaping the technical development of industry and holding the nation to an awareness of its power for greatness and goodness.

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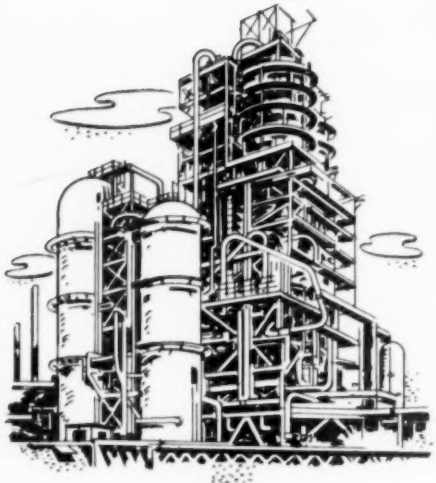

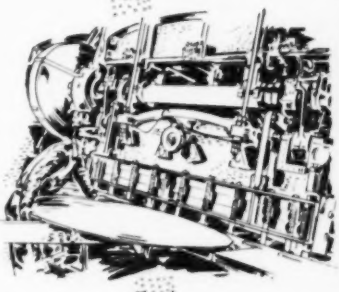

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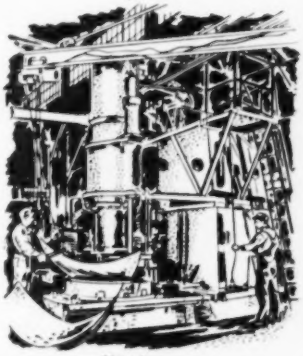

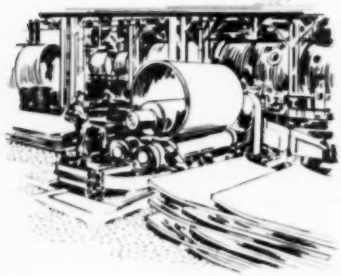

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